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Modern Explosives and their Practical Application on the St. Gotthard R. R. and the Corinth Canal.

COMPILED FOR ENGINEERING NEWS
BY GEO. J. SPECHT C. E.

The New Explosives, Gelatine and *Gelatine Dynamite*:—Nitro-glycerine was invented in 1847, by the Italian Sobrero, and first applied practically by the Swede, A. Nobel, in 1863. It is made by introducing pure glycerine into a mixture of concentrated, pure nitric and sulphuric acid, cooled to a certain degree of temperature. This process is analogous to that of making gun-cotton. Nitro-glycerine, being lighter than the acid, it is cleaned of any acid particles by washing; pure nitro-glycerine is a thick oily fluid, without smell or color, is sweet to the taste, with a specific gravity of 1.6. At 46° F. it freezes and loses considerable of its sensitiveness to mechanical action; ignited, it quietly burns without refuse, and produces carbonic acid, watery vapor, nitrogen and hydrogen, all, in themselves, perfectly harmless. When gradually heated to 356°, or when acted upon by powerful mechanical forces, by the explosion of certain substances or fulminate of mercury, nitro-glycerine explodes. The gases developed by explosion occupy 1250 times the original volume of the explosive, and by the high degree of heat evolved, this is again expanded eight times, so that the total expansion equals 10,000 times the original bulk.

The first dynamite made by Nobel consisted of nitro-glycerine absorbed by an infusorial earth, called *Kieselguhr*, or other similar incombustible substances. This mixture had the disadvantage of losing the nitro-glycerine under pressure, and even in water. No foreign substance of the kind used can absorb more than 75 per cent. of the nitro-glycerine, not even the *guhr*. If absorbents are used which contain saltpetre and are combustible, a large percentage of carbonic substances have to be used; saltpetre is a very poor absorbent and developes injurious gases.

"There are very many varieties of the lower grades of nitro glycerine powders, but they are essentially all alike in composition. As the quantity of nitro-glycerine to be taken up is moderate, great absorptive capacity is not required. Usually the absorbent is a mixture, composed of nitrate of soda, with one or more combustible substances, such as saw-dust, wood-pulp, charcoal, coal, resin, etc. If in such a preparation the nitrate and the combustible are properly proportioned and thoroughly mixed, they take part in the reaction and add force to the result. But in many cases these materials are in such bad proportions, or so imperfectly mixed, that little or no valuable action can take place between them."*

A. Nobel discovered that a very small amount, 2 to 7 per cent., of a certain kind of gun-cotton† is able to change nitro-glycerine into a substance of the consistency of syrup or gelatine, which, under the heaviest pressures and after months of exposure to moisture, will not lose any of the nitro-glycerine. This compound is called *Explosive Gelatine*, and in it the exact percentage of nitro-glycerine can be determined and guaranteed, which was impossible with the absorbents formerly used. These can now be replaced by mixtures, chemically correct and combustible, which will increase the gases developed and the strength of the powder.

These compounds, made of thick, gelatinized nitro-glycerine and nitric admixtures, are called *Gelatine-dynamite*, *New-dynamite*, or *Extra-dynamite*. The most common grade of this explosive, as used in Europe, is known as *Dynamite No.* 1, *new*, and contains 60 to 70 per cent. explosive-gelatine, and 30 to 40 per cent. of nitric admixtures; *Dynamite No.* 2, *new*, contains 40 to 50 per cent. explosive-gelatine, and 50 to 60 per cent. of admixtures.

The opinion of Prof. F. A. Abel, one of the strongest opponents of nitro-glycerine powders, and the author of the strict nitro-glycerine laws of England, is important in this connection. He expresses his firm conviction that the powders made of gelatinized nitro-glycerine will be the powerful explosive of the future (Explosive Agents, p. 54). By continuous investigations, Mr. Nobel proved that the addition of certain substances, soluble in nitro-glycerine, as benzine, etc., would render the explosive-gelatine insensible even to the strongest mechanical action. M. Trauze, of Austria, discovered that a small percentage of camphor, added to the explosive-gelatine, made it safe against the effect of bullets, even at a short distance; this last discovery is valuable for military purposes, and the compound, called *Military explosive-gelatine*, contains 96 per cent. explosive-gelatine and 4 per cent. of camphor.

Dynamite, No. 1, *old*, is a fatty, pasty, plastic and poisonous substance of a brown or reddish color, and with a specific gravity of 1.4. Explosive-gelatine is an elastic substance, yellow in color, and looking like amber; its specific gravity is 1.6. It is less sensitive to mechanical influences than *Guhr-dynamite*.

Experiments show that dynamite explodes under an applied force of 1 *meter kilogramm*, while gelatine cannot be exploded under 3.5 *meter kilogramm*. The latter is therefore safer than the first. Cartridges of gelatine, lying upon the ground and in no way confined cannot be exploded by 1 gramm (1.68 grs.) of fulminate of mercury. The direct use of caps with explosive-gelatine is uncertain; a primer of dynamite No. 1, new, must therefore be used in connection with triple-force caps.

The gelatine-dynamites, or new dynamites, are also less sensitive than the old, but they do not require an extra primer to explode them.

If the explosion is perfect, neither old nor new dynamite, nor explosive-gelatine, develop obnoxious gases; such gases are nearly always due to incomplete combustion.

At about 43° F. dynamite, old, and gelatine freeze; the frozen dynamite is exploded with much more difficulty than when in an unfrozen state; gelatine explodes most readily when frozen, but still not so readily as unfrozen dynamite.

If slowly heated *Guhr-dynamite* explodes at 356° F., and *gelatine* at 399° F., or if heated rapidly, at 464° F. An addition of 4 per cent. of camphor makes gelatine unexplosive at temperatures ranging from 572° to 626° F; it simply burns. Lighted in the open air, both explosives burn, in small quantities, without smoke, and the old dynamite alone leaves a residue, in this case of *guhr*. Moisture and a submersion of short duration under water does not affect the dynamite. If submerged for a longer period, placed in warm places, or subjected to vigorous s aking or to shocks, the dynamite may lose some of its nitro-glycerine. Some of the explosions in the St. Gotthard Tunnel can only be ascribed to the fact that heavy pressure separated some of the nitro-glycerine from the dynamite. No loss of nitro-glycerine from the gelatine has been observed under any of the above conditions, even after immersion in running water for several months. The color becomes a little lighter and it has a milky appearance in the latter case, but soon returns to its original state when exposed to the light. Even a pressure of $7\frac{5}{10}$ tons to the square inch cannot force any of the nitro-glycerine out of the gelatine, a further proof that the gun-cotton and nitro-glycerine are chemically and not merely mechanically united.

The chemical stability of the different explosives has been frequently investigated. The results of the tests made by the military commission of Austria are as follows:

1. Keiselguhr-dynamite, or Dynamite No. 1, old. *Temperature of Explosion.* When slowly heated from 140° F. it explodes at 366° F.; if rapidly heated to a high temperature it explodes at 352° F.; instantaneous explosion occurs at 446° F.

Resistance to Blows.—Laid in layers, $\frac{1}{32}$ in., thick, between steel plates, it explodes at a blow of 2.2 lbs.; when soft a rifle ball will explode it, but not when it is frozen.

Chemical Stability.—Inclosed in a glass tube and exposed to a constant heat of 158° F., for a period of 8 days no trace of free sub-nitric-acid vapors could be detected.

2. Explosive-Gelatine. *Temperature of Explosion.* When slowly heated from 140° it explodes at 399° F.; instantaneous explosion at 464° F.; military explosive gelatine (containing 4 per cent of camphor) only burns but does not explode at the temperature at which black powder explodes, viz: 572° to 626°.

* Munroe, Proceedings. U. S. Naval Institute, Vol. X. February, 1884.

† Gun-cotton, or pyroxyline, is a so-called nitro-compound, prepared by exposing dry cotton for a sufficient time to the action of a mixture of the strongest nitric acid with sulphuric acid (Drinker).

Resistance Against Blows.—In layers $\frac{1}{32}$ in. thick and with a surface of 0.207 sq. in., and laid between steel plates a blow of 7.7 lbs. is required to explode it.

Chemical Stability.—Exposed to a constant temperature of 158° F., for 8 days, in a closed glass tube, symptoms of disintegration took place.

3. GELATINE-DYNAMITE No. 1, or DYNAMITE No. 1 NEW. *Temperature of Explosion.* If slowly heated from 140° F., it explodes at 338°. Instantaneous explosion at 446°.

Resistance to Blows. In layers, as above described, it explodes with a blow of 3.85 lbs.

Chemical Stability. Same as explosive gelatine.

Instantaneous Explosion. In neither of the nitro-glycerine powders above mentioned have any cases been recorded of spontaneous explosion at temperatures occuring in the usual course of common practice. Gelatine has been used at the St. Gotthard R. R. since 1879, continuously and in enormous quantities. In the magazines of the Austrian army large masses of *Guhr-dynamite* have been stored for 1½ years, without showing the least sign of chemical change.

In this connection, Gen. Abbott, U. S. A., says:—"At Willets Point in the military magazines, where the winter temperature is low enough to freeze dynamite, there were three lots of dynamite stored; one sent by the Giant Powder Co., of San Francisco, in 1871; one by the Atlantic Giant Powder Co., in 1873, and another by the same company in 1876. There was no evidence of deterioration after a storage of five years, the powder being exposed to alternate freezing and thawing. They confirm the opinion, founded upon other grounds, that no deterioration is to be apprehended with the article supplied by these companies."

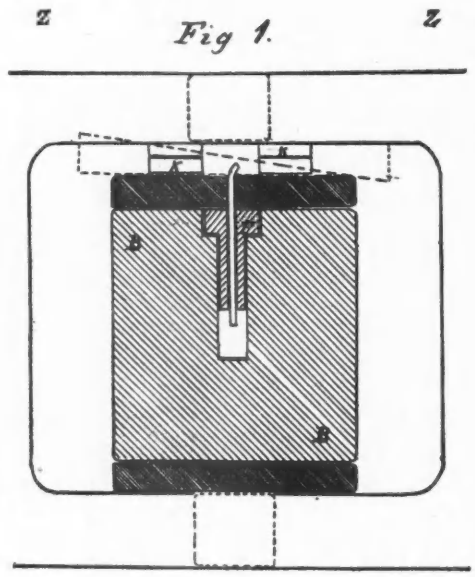
Gelatine is too powerful to be used where damage to the surroundings is liable to occur; also in the lateral enlargement of tunnels and in similar cases. Gelatine-dynamite No. 2 or No. 3 should be used under these conditions.

Summing up from what has been said above, we arrive at the conclusion that gelatine, other conditions being equal, has a much greater effect than *Guhr-dynamite;* is completely indifferent against the influence of water; very safe in transportation, storing and handling; permits strong tamping; and, when properly exploded, gives rise to a less quantity of obnoxious gas, than *guhr-dynamite.* It is therefore perfectly natural that it should supercede the other to such an extent that in most of the powder works in Europe, gelatine and gelatine-dynamite alone are made.

The pure gelatine has two disadvantages, namely, the difficulty of completely exploding the charges, unless the proper primer and exploder are used; and its extreme toughness and elasticity, which prevents the complete filling of the hole, even with heavy tamping. These defects are avoided by adding substances partaking of the nature of black powder. In making Gelatine-dynamite, or new-dynamite, 40 to 80 % of explosive gelatine is mixed with 60 to 20 % of a combustible or absorbent. This mixture has, in the higher grades, nearly the full strength of pure gelatine, and besides possessing all its good qualities, is sufficiently plastic to fill the holes completely. It can also be exploded in the same way as *Guhr-dynamite*, without the use of extra strong primers. Gelatine-dynamite is also the best primer for pure gelatine.

MEASUREMENTS OF THE STRENGTH OF EXPLOSIVES.—The customary method of testing the strength of explosives in America is by the use of the mortar. In Europe this test has been entirely abandoned, and it is replaced by the apparatus described as follows by Capt. Hess in his treatise "On Tests of the Strength of Explosives":—"M. Traurl, general manager of the Nobel Powder-works in Austria, tests the powder by placing it in a solid cylinder of lead, and by measuring the size of the cavity produced by the explosion, by water poured into it from a graduated tube.

Fig 1.



The apparatus is shown in Fig. 1. It consists of a lead cylinder, B B, 8 in. high and 8 in. in diameter, in the center of which is a hole, 1 in. in diameter, and drilled to such a depth that the center of the test charge coincides with the center of the lead-cylinder, i. e., 4.75 in. deep. The charge, of ¾ of an ounce, is wrapped in parchment paper or put in a tin box and provided with cap and fuse. The hole is then tamped with a closely fitting lead stopper, P, through the center of which a hole is drilled to permit the passage of the fuse. Lately this lead stopper has been abandoned and plastic clay, not too wet, substituted. The cylinder is laid between two steel plates, 1 in. thick each (S S), and the whole apparatus then wedged in a wrought-iron frame, Z Z, by means of the steel wedges, K K.

The explosion is hardly audible and it is entirely safe for the observer to stand in close proximity to it. The lead-cylinder is the only part of the apparatus which is changed in form by the explosion; the central cylindrical hole is widened to a bottle shaped cavity. The cubic measurement of this cavity will be different with the various kinds of explosives, and is ascertained by pouring in water from a glass tube graduated in cubic centimeters.

The following table gives the results of a series of tests made in Austria:—

Number	Name of Explosives	Composition of the Explosives.	Charge	Cubic Contents of Hole Before Explosion (Cubic inches)	Average of the Three Tests (Cbc. inch)	More than Dynamite No. 1 old. No. 1 old = 100 per ct (Cubic inches)	Less than Dynamite No. 1 old. No. 1 old = 100 per ct (Cubic inches)
1	Dynamite No. 1 old	75 per ct. Kieselguhr. 25 per ct. Nitroglyc.	¾ of one ounce, triple-force cap. 3.042	59.80	58.17		
2				56.14			
3				58.58			
4	Dynamite No. 1 new.	60 per ct. Expl. Gelat. 40 per ct. Absorbent.		73.22	74.24	16.07 27.7 pr. ct.	
5				73.22			
6				76.27			
7	Dynamite No. 2 new.	45 per ct. Expl. Gelat. 55 per ct. Absorbent.		56.74	57.97		0.20 0.3 pr. ct.
8				57.97			
9				59.19			
10	Dynamite No. 3 new (Primer).	25 per ct. Nitroglyc. 75 per ct. Absorbent.		42.71	43.93		14.24 23.5 pr. ct
11				45.15			
12				43.93			
13	Dynamite No. 3 new.	15 per ct. Nitroglyc. 85 per ct. Absorbent.		36.00	35.19		22.98 39.5 pr. ct
14				33.56			
15				36.00			
16	Explosive Gelatine.	93 per ct. Nitro-glycerine. 7 per ct. Gun-cotton. 80 per ct. Expl. Gelatine. 20 per ct. Dynam. 1 new.		91.50	92.55	34.38 59.1 pr. ct.	
17				94.58			
18				91.53			
19	Nitroglycerine.			109.22	108.91	50.74 86.3 pr. ct.	
20				106.78			
21				109.22			

From an examination of this table we learn:—

1. That the greater the percentage of nitro-glycerine, the greater is the effect of the explosive, provided that an incombustible absorbent is used, as *Kiesel-guhr*, for instance.

2. That if *guhr*, being incombustible and entirely inert, is replaced by a combustible absorbent, a considerable saving in nitro-glycerine can be effected, All combustible absorbents, used before the invention of explosive gelatine, were defective in the respect that they did not absorb the nitro-glycerine completely, and that the powder was always somewhat fatty or greasy. The invention of explosive gelatine has furnished the means of obtaining a perfect nitro-glycerine powder which will not lose a particle of the nitro-glycerine.

Gen. Abbott, U. S. A. gives the following figures, as representing the relative intensity of action of the several explosives when fired under water:

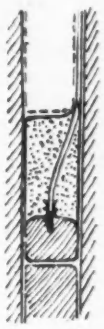
Explosive-Gelatine	117	Vulcan No. 2.	82
Dualin	111	Nitro-glycerine	81
Hercules, No 1.	106	Brugére Powder	81
Dynamite No 1.	100	Vulcan No. 1.	78
Rendrock	94	Electric No. 1.	69
Gun-cotton	87	Designolle Powder	68
Dynamite No. 2.	83	Electric No. 2.	62
Mica powder No. 1.	83	Mica No. 2.	62
Hercules No. 2.	83		

PRIMERS AND CAPS.—A strong and good primer is the principal condition of a perfect explosion. This was made especially apparent when explosive gelatine was introduced. During the first period of its use numerous complaints were made of inefficient explosion and very obnoxious gases. A new primer was then made, said to be composed of 56 per cent. of nitro-glycerine, 34 per cent. potassic salt, 6 per cent of carbon and 4 per cent. of gun-cotton; since the introduction of this primer the complaints have ceased. In wet grounds these primers should be put in the hole only at the very last moment, as they are affected by water, similar to dynamite. Triple-force caps are used. To test the strength and effi-

ciency of the different caps, their effect upon a plate of sheet iron was noted, the plate being supported only at the ends and the caps laid loosely upon it. This apparatus was enclosed in a wrought-iron box, with a hole through the cover for the fuse. The tests showed that a good cap should break a wrought-iron plate, 1.7 to 2mm. (0.066 to 0.079 in.) thick.

It frequently happens that, in tamping the holes, the caps and fuse are loosened from the primer and the charge is not exploded. Col. Locher, of Switzerland, advises the following as a remedy:—He made long paper shells or tubes, at the bottom of which the primer, with cap and fuse, is inserted, and the balance of the hole filled with fine dry sand. When the sand is poured in, the laborer presses the fuse against one side of the shell, and when this is filled he ties the end of the shell around the fuse. No "miss" has occurred since the introduction of this method.

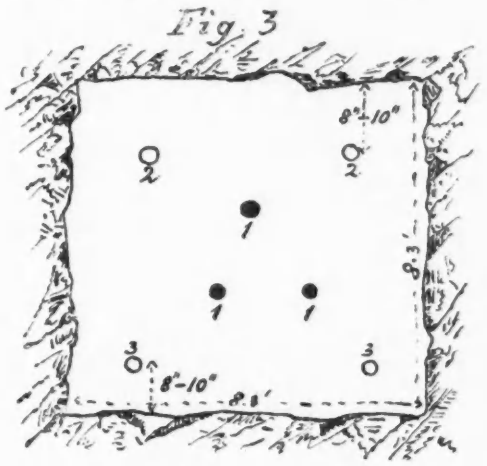
Fig. 2



LOADING, TAMPING AND BLASTING. The loading and tamping of the holes with dynamite is done in the usual manner. With gelatine, prepared sand tamping (loose sand in paper shells) is used; the opinions, however, differ as to whether water, loose sand, or prepared sand is to be preferred.

Fig. 3 shows the disposition of the 3½ in. holes, drilled by the Brandt drill in the Pfaffensprung Tunnel in hard, compact ground; 7 to 10 holes were drilled. The center holes, marked 1 in the figure, were first fired, the other holes in rotation as indicated by the numbers. The time was regulated by the length of the fuse. In softer ground, 5 holes were drilled by the Brandt drill. The area of

Fig. 3



the face in both cases was 70 sq. ft. In the St. Gotthard Tunnel the number of holes drilled in a face of from 64 to 70 sq. ft. was as follows:

In soft, micaceous schist, 18 holes, each 4.25 to 4.6 ft deep.

In medium hard gneiss, 20 holes, each 4.25 ft. deep.

In hard, compact, gneissic granite, 22 to 24 holes, each 3.94 ft. deep.

From 3 to 6 holes were center holes (Fig. 4); they were first loaded and fired; the other holes were loaded and fired as indicated by the numbers in Fig. 4. For the advance headings, explosive gelatine was used, almost exclusively, also in the lateral enlargement of the top headings. The other portions of the cross-section were blasted with dynamite, and the final completion of the excavation was done with black powder.

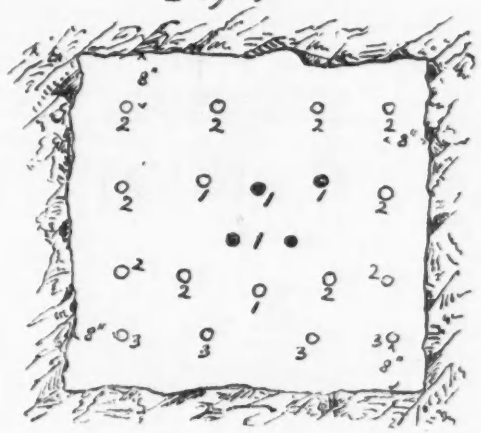
MISSED SHOTS. No accurate record has been kept of the missed holes, but in the Pfaffensprung Tunnel, after the introduction of the new primers described above, the misses were as follows:

April, 1880	1	Missed.
May, 1880	2	"
June, 1880	None	"
July, 1880	1	"

In missed holes, the tamping was removed for about ⅔ or ¾ of its length, then a cartridge, with primer, cap and fuse, was inserted, and the explosion of this charge set off the missed shot.

Some curious and unexpected explosions are recorded from the St. Gotthard Tunnel, where nitro-glycerine had been forced out of the dynamite cartridges and had found its way through crevices in the rock to the place where the new hole was being started. When the

Fig. 4



drill struck such a deposit an unforeseen explosion took place. This has never occurred with the use of gelatine.

SOME PRACTICAL BLASTING RESULTS.

In the Pfaffensprung tunnel—one of the circular tunnels in which the hardest granite on the whole line was met—1 cu. yd. of rock required (March, 1879, Dec., 1880)—

In the lower heading (cross-section, 8'×9') 5.5 lbs. of dynamite.

In the same lower heading (cross-section, 8'×9') 3.8 lbs. gelatine.

In the upper heading (cross-section, 9'×9'6") 3.1 lbs. of dynamite.

In the same upper heading (cross-section, 9'×9'6") 2.1 lbs of gelatine.

Which shows that the quantities required have the proportion of

Explosive gelatine: dynamite=1: 1.43.

In the great St. Gotthard Tunnel (9½ miles long), 1 cu. yd. of rock required (January and February, 1880, cross-section of advance heading 8'×9') 6.4 lbs. of dynamite, but only 4.2 lbs. of explosive-gelatine, which is a proportion of 1: 1.51.

Mr. Bossi, the chief engineer of the contractor of the great tunnel states, that where 1 lb. of explosive-gelatine was sufficient to produce a desired effect, it required 1.10 lbs. of pure nitro-glycerine, or 1.50 lbs. of dynamite No. 1, or 2,15 lbs. of dynamite No. 2 or No. 3, or 4.50 lbs. of common black powder.

The experience of the engineer in charge of the Freggio Tunnel—another of those circular tunnels of the St. Gotthard Railroad, about 5,000' long—was, that explosive-gelatine was from 1¼ to 1½ times as effective as dynamite No. 1.

The French Engineer Moreau states, that according to his experience by the use of explosive-gelatine, 20 per cent of labor was saved and 15 per cent in time was gained.

The general result of a 3 years' experience in the use of explosive-gelatine on the St. Gotthard R. R. was, that, under the circumstances the use of dynamite is 13 per cent. and the use of black-powder 18 per cent. more expensive in driving headings of tunnels, than that of explosive-gelatine. Explosive-gelatine is more difficult to explode than dynamite, requiring 3.5 times greater force, which makes the use of the former safer than that of the latter.

The question is often asked, why is not a larger variety of grades of explosives made, differing in the percentage of nitro-glycerine? The answer to this question is as follows:—

The variety of grades is not necessary. The percentage of nitro-glycerine is not as important as is generally supposed; the absorbent has a much greater influence upon the explosive value. Capt. Hess, in the before mentioned treatise, has arrived at the conclusion, that even in the simplest dynamite, the physical properties have as much influence as its chemical composition; and that, under certain circumstances, a dynamite poorer in nitro-glycerine may be more effective than one with a greater percentage of the same agents. The position, depth and size of the holes, depth of the charge and exploder used, exercise a greater influence upon the effect of the explosion. The experience of a number of years of use, is against the manufacture of any greater variety of grades than are now made. Another question sometimes asked is, is it possible for the manufacturer to guarantee an exact percentage of nitro-glycerine in his powders? This percentage can be absolutely fixed and guaranteed in explosive-gelatine. In the dynamites with absorbents, the exact percentage can be guaranteed in each quantity or charge, prepared at one and the same time. For instance, in a quantity of 55 lbs. of 65 per cent. dynamite (the usual quantity worked at one time) there will actually be 35.75 lbs of nitro-glycerine. But in the single cartridges made out of this charge, differences of 0.5 to 1 per cent. may occur, which however are without practical effect.

The foregoing notes are compiled from communications by M. Hugo Muench, in the publications of the Austrian Society of Architects and Engineers, and from a pamphlet of Prof. Texmajer, of Zurich, Switzerland, relating to the experience with modern explosives on the St. Gotthard R. R.

We follow with the experience of some American investigators. This experience differs in some essential points from that of Europe, as to the present date, neither explosive gelatine nor *new* dynamite is made in the U. S. except for experimental purposes; nor is it likely that the powder used by Gen. Abbot and Prof. Hill is of the same composition or as perfectly made as in Europe. The European experience is certainly of greater value as it is obtained from actual work, carried out under all kinds of conditions, and during a very considerable period of time.

Prof. Munroe says:—Explosive gelatine or gelatine dynamite is made by dissolving photographic gun-cotton in nitro-glycerine or by uniting nitro-glycerine with collodian, removing the solvent by evaporation. Nitro-glycerine with the aid of heat, dissolves soluble gun-cotton, forming a gelatinous mass of firmness varying with the amount of gun-cotton contained. At 160°-170° F. solution of the gun-cotton and gelatination quickly takes place. In explosive gelatine the nitro-glycerine is very strongly retained, not being given up under heat or pressure. Explosive gelatine is very insensible to blows and is not easily exploded, requiring a very powerful fuse, and is not injured by water. Various substances may be mixed with the materials and in preparing this agent to form mixtures of different kinds. Camphor dissolves freely in nitro-glycerine, so that camphorated explosive gelatine can easily be made containing it in any desired proportion. This preparation is even more insensible to blows or other mechanical action than the simple gelatine.

When struck by a rifle bullet fired at a distance of 80' it does not explode . . . . It is considerably stronger than dynamite (75 per cent.) or compressed gun-cotton, and it is very free from liability to accident or injury in use or transportation. On the other hand its stability is a matter of question. Instances of its decomposition on keeping or after long exposure to moderate temperatures have been observed. It is probable that this difficulty may be removed. Soluble gun-cotton is apt to contain traces of free acid and to vary greatly in composition. Special care must be taken in making the gun-cotton to insure uniformity and complete purification. If this tendency

(CONTINUED ON PAGE 8.)

The Pœtsch Method of Shaft-sinking.

In our issue of June 7th, we gave a description of the method of shaft-sinking through water bearing strata, by freezing, as lately invented by Mr. F. H. Pœtsch, of Aschersleben; we now supplement this description by an illustration of the plant used and its application at a shaft now being sunk for Dr. Warner Siemens at the *Centrum* Mine, near Berlin. The drawing from which we copy our illustration comes directly from Mr. Pœtsch himself.

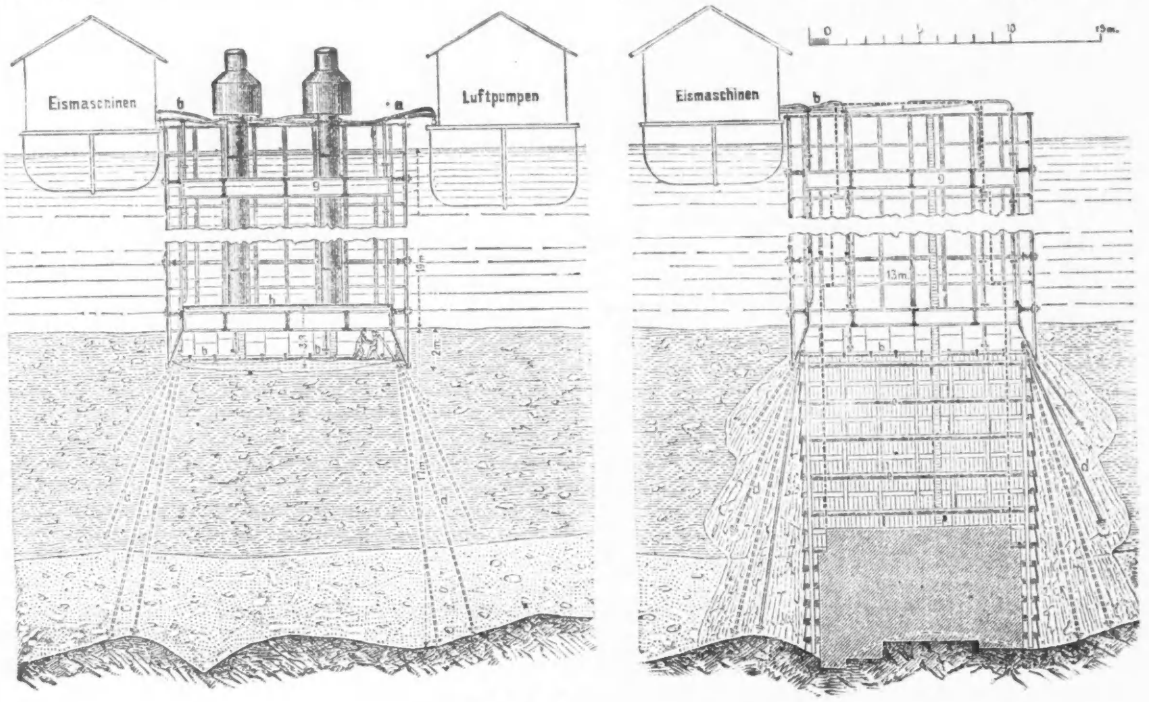
The fact that the simplest method of proceeding in any important work is the one last thought of, is strikingly illustrated in the very novel plan suggested and practised by this German engineer. The presence of water has always been the one great obstacle in shaft-sinking and in the securing of foundations generally, and the history of engineering progress, in all lands, is filled with the detail of the trials, and failures in many cases, of man in his attempts to conquer this most powerful foe. The application of compressed air in such cases was a step forward, but it is limited practically to depths of about 100 ft., beyond that the air pressure required exceeds the limit of human endurance. Mr. Pœtsch now steps in with an invention which does away with pumps and air compressors, and by transforming the surrounding liquid soil into a wall of solid ice, excludes the water entirely, relieves the shaft-walls from pressure until they are in a condition to withstand any probable strain, and reduces the problem of shaft-sinking to the level of work in hard, dry ground.

He has taken advantage of certain solutions whose freezing point is much below that of water, such as a solution of chloride of magnesium which requires a temperature of 40 below zero to convert it into a solid mass. The method of circulating this freezing liquid through the strata to be penetrated, is fully shown in the accompanying cut and the previously published description, and we will not repeat it here; it is sufficient to say that its success has been proven, in cases where all other known methods had previously failed.

The Pœtsch method was first tried at the *Archibald* colliery, near Schweidlingen, Prussia (described in ENGINEERING NEWS, June 7), where a vein of quick-sand, 20 ft. thick, was encountered at a depth of about 150 ft. below the surface; here 23 pipes were used, and 35 days consumed in the freezing process, under local difficulties cited in our description. The second was at the *Centrum* mine, illustrated in the present issue, where about 107 ft. of quick-sand, etc., has to be penetrated. This shaft had baffled engineers for years in their attempts to sink it; but in 33 days Mr. Pœtsch had secured a 6 ft. wall of ice around the shaft area, with only 16 freezing tubes, and the shaft is now being excavated and curbed without difficulty. The third piece of work is at present under way at the *Nimilia* mine, Fensterwalde, where a 9 ft. shaft is being sunk through 120 ft. of quick-sand stratum, and the inventor has contracted to finish it by July 15th. And we are just informed that Mr. Pœtsch has closed a contract to sink a series of bridge piers near Bucharest, Austria, applying his method.

This last contract will be watched with especial interest, as the inventor claims, and seemingly with justice, that this freezing plan opens up possibilities, in founding bridge piers, before undreamed of. As opposed to the compressed air process, the main advantages are in the practical want of limitation in depth, and the relief of the laborers from the effect of the severe atmospheric pressure.

We are indebted to the *Techniker* for the accompanying cuts illustrating the application of this process to the founding of bridge piers. Two cases are given; the first combines the Pœtsch method with the pneumatic process, but in this case after the working chamber has been sunk to and into the river-bed, the congealing tubes are applied and the entire mass between the caisson and the rock frozen solid. As the caisson will then be practically sealed against the entrance of water, the air-lock can be removed and the masonry built up as in the open air. In the second case, compressed air is entirely dispensed with; an open caisson being sunk over the site of the pier and the freezing tubes put down through the water; when the congelation is completed the caisson can be pumped out and the work done in the open air.



Application of the Pœtsch Method to Pier Foundation.

Neither of the above methods have yet been practically tested, but as before mentioned the attempt is about to be made at Bucharest. Its application to any special case would be controlled by the local circumstances; such as depth of water, thickness and character of the mud or sand deposit and the currents and temperature of the water. In laying the masonry, precautions would also have to be taken to counteract the effect of the extreme cold upon the stone and the cement: Mr. Pœtsch believes that the interposition of straw, cotton-refuse or other non-conducting material between the masonry and the ice-wall would accomplish this; and for a cementing material, a composition of tar, pitch or asphaltum and sand could be used, as these are not effected by frost.

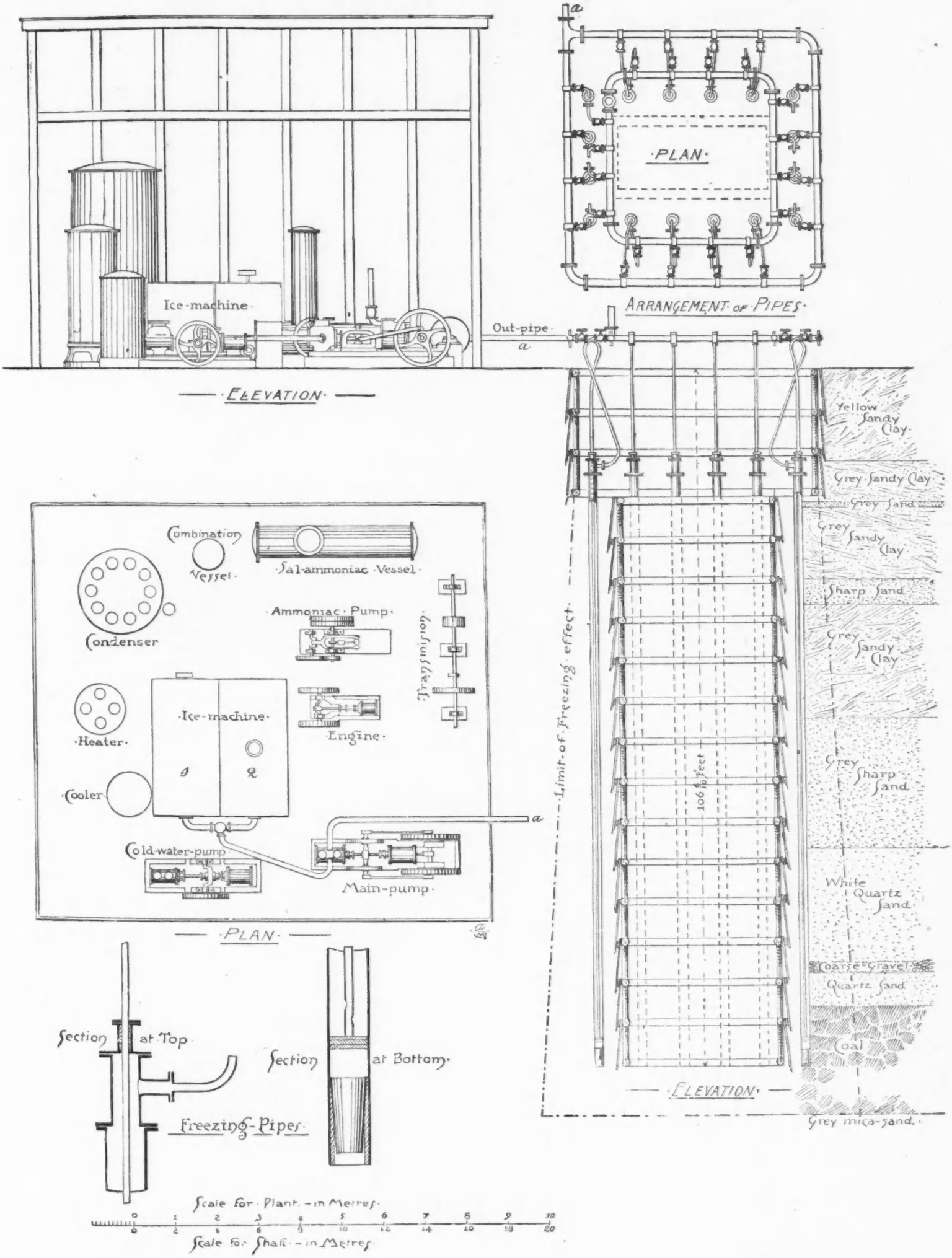
The sinking of the pipes is done by aid of the water-jet. In the *Centrum* mine illustrated, the large pipes were sunk with open ends, and afterward closed by a leaden plug and alternating layers of cement and asphaltum, with iron washers between, to prevent the escape of the congealing liquid. This method was found to be expensive and wasteful of time, and in the later work three pipes are used, the outer one merely to secure an opening into which can be sunk the two circulating pipes; in this case the bottom of the large pipe is closed by welding it together before putting in position. The entire plant can be used on any number of different works, as the pipes can be recovered as soon as the ground surrounding the shaft thaws out. The cost of sinking by this method is in proportion to the depth, and the time consumed in freezing is in similar ratio. The plant costs, in Germany, about $30,000.

As this method can be applied horizontally as well as vertically, it seems that an excellent point upon which to test its value in this country would be the Hudson River Tunnel. In this case the silt and sand is very uniform in composition, and it should be no difficult matter to congeal the material in length of 100 or 150 ft. at one operation.

For the drawing and the data here used, we are indebted to Mr. Alex. Bernay, who is now in the United States as agent for Mr. Pœtsch (address, Park Hotel, Hoboken, N. J). Mr. Bernay is a Civil Engineer, and has had personal experience in the use of this new method of shaft-sinking in his previous connection with the inventor.

An English Army Scandal.

A great scandal is growing out of the disclosures being made before the select committee of the House of Commons appointed to investigate the charges against the transport and commissariat departments in the Anglo-Egyptian campaign of 1882. The exposures are growing more startling day by day, and already exhibit a condition of affairs described as "more shameful than anything ever displayed even in American politics." It has been shown that the hay sent to the army for forage was no only moldy, but was loaded with stones and bricks to make up for its short weight. Every device conceivable by rascality was resorted to to bleed the treasury. Cattle intended for food for the troops were landed from the transports and then untended until hundreds of them strayed over into the enemy's lines, and more had to be ordered from home. The troopships and transports were in many cases overloaded when they left England to such an extent that the stores had to be thrown overboard while proceeding to the front, in order to save the vessels. At the Woolwich arsenal they made branding irons the size of frying pans for the live stock, and the result of the use of these barbarous instruments was that hundreds of mules for which treble their value had been paid were disabled and rendered useless until after the close of the campaign. Hundreds of these branding irons are now piled up among the condemned stores at Woolwich. Officers of the commissary department have testified that they received word from time to time of outlying detachments of British troops who were literally starving, but to whom it was impossible to send food because of the utter inefficiency of the transportation service. The officers selfishly added to the embarrassment of the commissariat by bidding against one another for the services of native laborers, to be used as servants, thereby enormously increasing their wages and demoralizing the labor market. The officials of the war and foreign offices are eagerly watching this testimony as it is being developed, in the hope of shifting the blame, which has been liberally bestowed of late upon other shoulders.—*Army and Navy Register.*



THE PŒTSCH METHOD OF SHAFT SINKING BY FREEZING.

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TABLE OF CONTENTS.

	PAGE
Modern Explosives and their Practical Application on the St. Gotthard R. R. and Corinth Canal, *(Illustrated)*	1
The Poetsch Method of Shaft-sinking *(Illustrated)*	4
An English Army Scandal	4
Corrosion of Cast-iron Pipes	5
New England Meteorological Society	9
Personal	6
The Longest Bridges in the World	7
A New System for Operating Switches and Signals	7
London Wood Pavements	7
Water Supply in England	7
The Channel Tunnel	9
Correspondence	9
Mexican Water-works	9
An English View of American Inventions	9
The Drainage and Sewerage of Mexico	10
Sanitary Institute of Great Britain	10
Texan Railroads	10
Granite Pavements	11
Conventional Colors	11
News of Week	11
Water	11
Railroads and Canals	12

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WE would call the attention of our readers to the nature of the contributions of Mr. Geo. J. Specht, C. E., of San Francisco, which from time to time have appeared in this journal.

Mr. Specht, who is himself a highly educated and experienced engineer, has been connected with the work of construction on the St Gotthard Railway, and upon other public works in Europe, and the compilations, translations and original matter which he has spread before the readers of ENGINEERING NEWS have an especial value, as coming from one who knows of what he speaks.

His article upon the Brandt drill made a stir among the American manufacturers of rock-boring machinery, and caused decided steps to be at once taken looking towards its introduction into this country; and the paper upon Modern Explosives, which appears in this issue, is the latest and most complete contribution upon this interesting subject which has yet been presented to the American Engineering public.

The fact that these papers are mainly compilations and translations in no wise detract from their value: the sources of information are inaccessible to the great mass of American Engineers, and they should be correspondingly thankful to Mr. Specht for the intelligent industry which he has displayed in presenting them for publication on this side of the Atlantic.

These papers furthermore prove the wise policy, prevailing in Europe and frowned upon here, of engineers publishing full details of their work, and spreading the light of individual experience in all branches of the wide profession of civil engineering. Similar papers on American practice would be impossible, in the majority of cases, because the data is not on record; it is either suppressed by professional jealousy, or ignored as unimportant and unworthy of publication.

It is the detail that is wanted, as we have frequently pointed out; and the more minutely this is set forth the more truly valuable is the contribution. The careful study of work already done means progress in the work to come; an improvement on old methods; new ideas and the general advance of the profession and its individual members.

The Longest Bridges in the World.

A late number of the *Moniteur Industriel* gives the following as a list of the 26 largest bridges in the world:

The Montreal Bridge over the St. Lawrence,	8,791	L. ft.
Brooklyn, over the East River,	5,989	"
Rapperswyl, Lake Zurich,	5,333	"
Volga, over the Sysran, Russia,	4,947	"
Moerdyck, Holland,	4,927	"
Dnieper, near Jékaterinoslaw, Russia,	4,213	"
Kiew, over the Dnieper,	3,607	"
Barrage-bridge, Delta of the Nile,	3,353	"
"Kronprinz Rudolph," over the Danube at Vienna,	3,266	"
Dnieper, near Krementchoug, Russia,	3,250	"
Bommel, over the Meuse, Holland,	3,060	"
Two Bridges of Rotterdam, over Meuse,	2,833	"
Mississippi Bridge (?),	2,588	"
St. Louis, over the Mississippi,	2,574	"
Saint-Esprit, over the Rhone, France,	2,460	"
Kiulinbourg, over the Rhine, Holland,	2,347	"
Cincinnati, over the Ohio,	2,233	"
Chaumont Viaduct, Valley of the Suize, France,	2,000	"
Menai, England,	1,957	"
Cubzac, over the Dordogne,	1,817	"
Varsovie, over the Vistula,	1,693	"
Iron-bridge at Bordeaux, over the Garonne,	1,667	"
Stone-bridge " " " "	1,623	"
Beaucaire, over the Rhone,	1,460	"
Tours, over the Loire,	1,457	"
Alexandre, at St. Petersburg,	1,350	"

Of the above, the sixth on the list has just been opened; the Rapperswyl bridge is merely a pile structure and is only 13 ft. wide; the Sysran bridge over the Volga, carries the Orenbourg Railway, and was only finished in 1880; it has 13 spans, and is raised 131 ft. above the level of the river; it cost 13,500,000 francs ($2,700,000).

The Moerdyck bridge carries the Anvers and Rotterdam railways over the Meuse, which is about 8,800 ft. wide at this point, and has been reduced by dykes; it has 14 spans of 328 ft. each. It was commenced in 1868 and finished in 1871; it cost about 12,000,000 francs ($2,400,000).

The above list is given as printed, but the compiler in the *Moniteur* has in his table wholly ignored many of our long American bridges. A complete list of the length of modern iron bridges is not just now accessible, but among the omissions may be noted:—

The B. & O. bridge, at Havre de Grace (being built),	6,000	L. ft.
Wooden bridge at Columbia, Pa.	5,366	"
Louisville R. R. bridge, over the Ohio,	5,218	"
Cincinnati Southern R. R. over Ohio,	3,950	"
Havre de Grace bridge, over Susquehanna,	3,271	"
Dauphin bridge, over Susquehanna,	3,590	"
Monongahela bridge, near Homestead,	5,300	"
Plattsmouth bridge, over Missouri,	3,000	"
Quincy bridge over Mississippi,	2,847	"
Omaha bridge, over Missouri,	2,750	"
Keokuk, Iowa over Mississippi,	2,008	"
La Crosse bridge, over Mississippi,	1,672	"
Booneville bridge, over Missouri,	1,651	"

To the above many other long bridges could doubtless be added, were the data at hand. The longest bridge in the world was the late Tay bridge, which was 10,320 ft. in length, and the Forth bridge now under construction is to be about 9,200 ft. long. Although it does not strictly belong to the class in question, the N. Y. Elevated Railway is really a continuous iron truss bridge, and the aggregate length is thirty miles.

New England Meteorological Society.

On June 27th, a society was organized in Boston, Mass., to be called the "New England Meteorological Society." The purpose of this society is to aid the advancement of meteorological science. The following officers (who also act as the executive council of the society), were elected:

President.—Professor W. H. Niles, of the Institute of Technology.

Treasurer.—Desmond Fitzgerald, C. E., Brookline, Mass.

Secretary.—Professor William Davis, Harvard University.

Councillors.—Professor Winslow Upton, Brown University; Edmund B. Weston, M. Am. Soc. C. E., Providence, R. I.

PERSONAL.

P. K. YATES, Civil Engineer, of Canojaharie, N. Y., was married, on the 25th ult., to Miss Elizabeth S. Smith of the same place.

GEORGE W. BIRD, formerly of Frankford, Pa., has been elected City Engineer and Surveyor of Fargo, Dakota.

Mr. J. H. MURPHY, supervisor on the Pennsylvania railroad Lancaster, read a paper on "Maintenance of Way Material Reports" at the monthly meeting of the R. R. S. Institute, at Altoona, on June 25th. General Supe. intendent Prevoost presided at the meeting.

THE Albert Medal of the Society of Arts instituted in 1862 as a memorial of the Prince Consort, and given annually "for distinguished merit in promoting arts, manufactures, of commerce," has been awarded by the council of the society, with the approval of the Prince of Wales, the president, to CAPTAIN JAMES BUCHANAN EADS.

MR. JOHN MACLEOD has resigned the General Superintendency of the Louisville, New Albany & Chicago Railway, and will devote all of his time to the management of the Kentucky and Indiana Bridge Company, of which he is the Chief Engineer, and which is now constructing a steel Railway and Highway Bridge over the Ohio River at Louisville Ky.

THE Secretary of the American Society of Civil Engineers, announces the death, on Monday, June 30th, 1884, at his residence in this City, of C. VANDERVOORT SMITH, Past Director of the American Society of Civil Engineers. The funeral services were held at the Church of the Holy Trinity, corner of Madison Avenue and 42d Street, New York City, Thursday morning, July 3d, at half-past ten o'clock.

EDWIN K. HYNDMAN, well-know in railroad circles, died at his residence in Pittsburg, Pa. on the 26th ult. of consumption. He was 40 years of age and had been engaged in railroading for 24 years. He was first employed to forward coal trains on the Lehigh and Susquehanna, of which road he became Superintendent. When the Baltimore and Ohio took possession of the Pittsburg and Connellsville, he was made Chief Engineer and subsequently Superintendent, and in time rebuilt the line. He retired from this position to push the affairs of the Connellsville Coal and Iron Company, and while there was appointed General Manager of the Wabash system, with head-quarters in Pittsburg. He was afterward employed in a similar position on the Pittsburg and Western, which road was built under his superintendency, and at one time was President of the Pittsburg Junction Railroad.

MR. WESLEY ROYCE, of Toledo, O., for twelve years assistant Engineer and draughtsman in the office of J. D. Cook, the well-known hydraulic Engineer, was Elected Superintendent of the Columbus, (Ohio) Water Works, Dec. 1, 1883, to supply the vacancy caused by the death of the former, and very efficient Superintendent, Frank Doherty. The selection of MR. ROYCE to fill so responsible a position is the best evidence of his reputation as an hydraulic engineer.

ROBT. B. STANTON, C. E., and J. G. RIDGLEY, Mining Engineer, have opened an office as Civil, Mining and Consulting Engineers, under the name of RIDGLEY and STANTON, in Burlington Block, Denver, Colo. Mr. Stanton has been a subscriber to ENGINEERING NEWS for many years. The Denver *Journal of Commerce* says:

"Mr. R. B. STANTON is best known in Colorado as the Engineer of the Colorado Division of the Union Pacific R. R., which important position he has held for years, but recently resigned to become a member of this firm. His former experience in building one of the mountain divisions of the Cincinnati Southern R. R. and his recent work of building the Georgetown, Breckenridge and Leadville "high line", mark him as an able engineer; at present he is Chief Engineer of the Denver Circle R. R.

Mr. J. G. RIDGLEY ranks with the most thorough and reliable mining experts in the State of Colorado. He is also associate editor of the *Rocky Mountain Mining Review*, the leading mining publication in the State, and has contributed many articles to eastern mining journals.

This firm furnishes surveys and estimates for railroads, irrigating canals, and reservoirs; and for water supply, drainage and sewerage of towns. Examine mines, ores, and machinery and furnish reports on the value of mining property, and the best way and means of working mines and ores."

Corrosion of Cast-iron Pipes.

Mr. Samuel McElroy, while handling the above-named subject in a paper by him read before the Western Society of Engineers, claimed that a likely cause of corrosion in cast-iron pipe was to be traced to the class of raw material employed, with the defective system of manufacture pursued in ordinary foundries greatly aggravating the original trouble arising from the use of inferior pig.

In the first place, a cheap and easily melted pig is selected—specifications and the inspection of quality and mixture not being strict—and the castings (for convenience of handling) are generally made in green sand moulds laid at a slope of about 10 degrees from the horizontal.* Impure metal is therefore run in a way that aggravates its defects. The core bars are coated with loam more or less soft and wet, and sprinkled with sand.

If not very carefully wedged, these bars will rise; and they are seldom stiff enough to resist the upward pressure of molten metal. The usual spring at the center for the core of an 8 inch pipe is 1-16 or ¼ inch; or as much as 3-16 inch with a 6 inch pipe. The metal, poured in from the upper end, first fills the lower section of the mould; and as it rises round the core to fill the upper section, its weight springs the bar upward to the extent indicated, making the casting thicker at the lower, and thinner at the upper side. The denser, hotter, and purer metal fills the lower portion; the impurities naturally floating upward to settle in the thinner metal as it cools. Here gather portions of the sand coating of the mould; while the bubbles of the metal, caused by the development of gas from the vegetable matter of the loam, and from its dampness, tend to perpetuate themselves in blisters and air cells.

The usual defects in these cheap castings are, therefore, inequality in thickness, air cells and blisters, sand holes, cold chutes from chilled metal, and mixtures of sand and iron. Such pipes are also frequently out of line, rom the effect of unequal contraction. Pipes of this description are peculiarly liable to corrosion; containing as they do mixtures of metals of different densities, together with much graphite. The duration of such pipes in the ground is largely affected by the amount of disturbance they receive. If well laid at a good depth, and thoroughly packed, they may continue serviceable for many years; but their defects are likely to become suddenly prominent upon comparatively slight external interference. In favorable circumstances they may last more than 30 years; but the majority if tested after less use will show flaws that would have insured their rejection if detected when new.—*American Gas Light Journal.*

[*Will Mr. McElroy specify the Pipe Foundries in the United States where the above method of Casting iron pipe prevails? ED. ENG. NEWS.]

A New System for Operating Switches and Signals.

George Westinghouse, Jr.'s system of pneumatic appliances for moving switches and signals was tried at Wilkinsburg Pa. where eighty passenger and innumerable freight trains are daily crossing. All this crossing and recrosing is accomplished by one man in the tower by a simple movement of a lever for each train. This operation has perfect command of twenty-one switches, ranging in distance 1000 feet on either side of the tower, and twenty-seven signals, the furthest of which is 2500 feet distant.

The air which furnishes the power is compressed at the shops. When it is desired to move a train, its proper switch is set, and not till then is the operator enabled to clear the signals to the trainmen. This is an important feature, in as much as no carelessness of an individual can result in accident, for the machinery will not work otherwise than in the order of the switch prepared first and signal afterward. Though trains may be moved simultaneously on parallel routes, it is an absolute impossibility to move two trains on the same route at the same time; the one in hand must of necessity be disposed of finally, so far as the switches and signals are concerned, before another can be manipulated. In addition to these precautions of device, the four main tracks will be protected by block signals, worked pneumatically, the erection of the plant being now under way. The movement to a switch is transmitted by the operator pulling a small lever, which lets compressed air into the switch cylinder, right or left, depending on which way it is to be moved This having been accomplished, the signals are cleared in a moment, the train crosses to its proper track and the operator is ready for the next comer.—*Troy (N. Y.) Tribune.*

London Wood Pavements.

Bishop Bedell writes to the *Evening Post* from London:

"For fear the enclosed suggestive statement may miss your eyes, I beg to enclose it, from the *Times*, of Monday, June 9. The pavements here are incomparably superior to ours in New York, and the wood pavement and the macadamized might surely be reintroduced with effect.

There are at the present time 53 miles of wood pavement in the metropolis, the streets of which extend in the aggregate over 1,966 miles, including 248 miles in course of formation. The construction of these roads and streets is as follows: 573 miles of macadam, 280 of granite, 53 of wood, 13½ of asphalt, and 798½ of flints or gravel. The wood pavement as at present laid down, is 980,533 square yards, its cost being estimated at £600,000. The majority of the London pavements consists of rectangular blocks of yellow deal, principally Swedish, which seems to be the most fitted of all woods to withstand wear and tear and atmospheric changes. Pitch pine is the most suitable of the hard woods, the vertical wear of the section in King's Road, Chelsea, during a year being only 0.055 inches. Elm or oak do not stand changes of temperature well; larch is better suited, but the supply is not sufficient to allow it to be much used. Creosoting the blocks, which was once very much in favor, has been found to be of little value as preservative, the creosoted blocks being no more durable than the plain ones, while the surface was less clean and there was a tendency to more rapid internal decay. Moreover, they are 20 per cent. more costly. The plain system has been in use in the Chelsea district for five years and has answered its purpose well, affording good foothold for horses and being safe and smooth for vehicles, while the cement grout used for filling the joints keeps out the wet and does not allow dirt to accumulate. The net cost was 10s. 6d. per square yard, and but very few repairs have been found necessary, and, taking the life of a block at seven years, the first cost, repairs, renewals, and cleansing, spread over twenty years, amounted to 1s. 9d. per square yard per annum, and spread over fifteen years to 2s. 1¾d. Comparing this with the maintenance of macadam, the balance is decidedly in favor of wood pavement, the annual repairs of Parliament Street and Whitehall when macadamized amounting to 2s. 10d. The plain system of blocks appears to be that which has the best reputation, considerable areas now being laid in Marylebone, Chelsea, and Paddington parishes. A good part of the city is laid by the Improved Wood Pavement Company, which has also operated on Westminster, Piccadilly, Bond Street, Brompton Road, etc. There are also Henson's system, the asphalt system, the "Keyed" pavement, the ligno-mineral pavement, Carey's pavement in Cannon Street, and Mowlem & Co.'s pavement, all of which have had more or less success.

Water Supply in England.

A letter from Mr. Baldwin Latham, C.E., has been published, in which the writer says that from observations which he has been conducting for some years in various parts of England, he is able to point out that if a line is drawn north and south through Leicester, in all places near that line the quantity of underground water stored in the new red sandstone, oolite, and the chalk is about equal to its normal quantity at this period of the year; in places to the west of this line there is an increase of water beyond the normal quantity, while in places to the east, there is a marked deficiency in the quantity of water stored in the ground. The springs in the chalk in the North Downs, which furnish the perennial supply of water to the streams of Surrey and Kent, are now at a lower point than they have been at any corresponding period for many years past, and we shall probably have this year a smaller flow in the River Thames than has occured for a considerable period. At the present time the upper tributaries of the Thames, taking their supply from the chalk of Wiltshire, contain an abundance of water, more than at the corresponding period last year, but as we pass eastward towards London, the supplies are of a limited character, and, in all probability, within the area of the River Lea, we shall have this year a lower state of the water than has been recorded for many years past, as within the drainage area of this river and north of it, passing into the oolite districts of Northamptonshire, there is a marked deficiency in the quantity of water stored.

From records of underground water, it appears that there is a marked deficiency of water in the ground every ten years; for instance, there was a deficiency in 1854, 1864, 1874, and, in all probability, this low water will occur again this year. Although it is most marked at the present time in the southeast districts of England, yet from the rapidity with which the springs are now falling in other parts of the country, the evidence all points to a general low state of the water in the autumn of this year.

Whenever the water in the ground has reached a considerable degree of lowness, when replenishment commences, in all places in which the water is liable to pollution we have the conditions which bring about epidemics of typhoid fever, and it therefore behooves all persons who are suspicious of the quality of their water supply to take the precaution to have all water used for dietetic purposes boiled before it is used during such periods as we are now entering upon. By adopting this precaution, much illness and suffering may be prevented.—London *Architect.*

(CONCLUDED FROM PAGE 3.)

is overcome it is probable that explosive-gelatine may be valuable for military purposes.

Some of the instances of decomposition of explosive-gelatine have been cited in these Proceedings, Vol. VII. p. 486.

In a preparatory note to Addendum I. of Gen. Abbot's report upon Submarine Mines, he states that "all the samples of the explosive-gelatine remaining on hand after the trials detailed in the report, have undergone spontaneous decomposition, separating into cellulose and free nitro-glycerine with the copious evolution of nitrous fumes. This change occurred during the winter and spring of the current year (1881-82) and was not caused by any exposure to high temperatures while in store."

A case of spontaneous decomposition of a small amount stored, freely exposed to air, in a dry room of even temperature, has occurred under my own observation.

The camphorated explosive-gelatine was wrapped in paraffine paper and then in light brown wrapping paper. After something more than one year's exposure it was found in the early winter to be giving off nitrous fumes which had stained the wrapping paper, and to have shrunk considerably in volume, and that the outside of the paper was covered with congeries of fine "crystals, while the odor of camphor was very strong."*

Gen. Abbot experimented with gelatine prepared for him by Prof. Hill, of the Naval Torpedo Station at Newport, R. I. This powder was made at 89 per cent. of nitro-glycerine, 7 per cent. of collodion gun-cotton and 4 per cent. of camphor. The general says, in his report on "Submarine Mines," pg. 104.

The following experiments were made upon the gelatine, when unfrozen, to test the effect of violent concussions. A slice ½ in. in thickness was suspended in paper and pierced by a bullet from the regulation Springfield rifle, fired at 25 yds.; result, nil. This experiment was repeated, without explosion, when the gelatine was backed by an inch board. The range was then increased to 45 yds., and the bullet passed with a like result through the explosive and flattened against a half inch iron plate, against which it was resting. Finally a 10 lb. slab was lashed to a vertical board one inch thick, and was pierced by a service bullet at a range of 100 yds. The ball thus traversed about 3 in. of the gelatine, without effect. In all these experiments the explosive was in its semi-transparent, jelly-like condition.

To test its tendency to sympathetic explosion, a few experiments were carried out. Half-pound cartridges, wrapped in paper, were submerged 5 ft. below the water surface, at distances of 15, 10, 5 and 3 ft. from a fuze-can containing one pound of dynamite No. 1. Detonating the latter produced no effect upon the explosive-gelatine. Under like conditions, Dynamite No. 1 (old) explodes up to a range of 20 ft.

These experiments, confirmatory of those reported abroad, show that the new explosive possesses much less liability to accidental, detonation than Dynamite, No. 1, an advantage which in military operations can hardly be over estimated * * * * Water produced no exudation of nitro-glycerine, another important advantage over Dynamite, No. 1, from which, as already stated, it abstracts the nitro-glycerine to a greater or less extent, dependent upon the compactness of the material."

On page 135, Gen. Abbot says: "A careful consideration of these several advantages and disadvantages has led the Board of Engineers to the conclusion that Dynamite No. 1, should be adopted provisionally, as the best explosive for our service * * * * As new explosives appear they are carefully tested; and it is not improbable that the trials now in hand with explosive-gelatine may show it to be a formidable rival." Gen. Abbot's experiments were made from 1869 to 1881.

COMPOSITION OF DIFFERENT KINDS OF EXPLOSIVES:

General Abbot in his "Submarine Mines" mentions the following kind of explosives, examined by him in 1876:

Dynamite No. 1. (Atlantic Giant Powder Co).
75% nitro-glyceri e. 25% absorbent.

Dynamite No. 2. (Atlantic Giant Powder Co.)

Nitro-glycerine	36%
Potassium or sodium nitrate	48%
Sulphur	8%
Resin, powdered coal or charcoal	8%
	100

Vulcan Powder (Warren):

Nitro-glycerine	300
Sodium nitrate	525
Charcoal	105
Sulphur	70
	1,000

Mica Powder, (G. M. Mowbray):

Finely divided mica scales (a non-absorbent silicate of alumina) and tri-nitro-glycerine in the proportion of 475 of the first to 525 of the latter. Two grades were made, No. 1 with 52% and No. 2 with 40% of nitro-glycerine. It was largely used at the Hoosac Tunnel.

Hercules Powder (California Powder works):

No. 1. XX.	Nitro-glycerine	77%
	Magnesium carbonate	20%
	Wood-pulp	2%
	Sodium nitrate	1%
		100
No. 2	Nitro-glycerine	420
	Sodium nitrate	435
	Wood-pulp	110
	Magnesium Carbonate	35
		1,000

Electric Powder (N. M. Barney, Titusville, Pa):

No. 1, nitro-glycerine 33% } Absorbent was
No. 2, " " 28% } kept a secret.

Designolle Powder:

Potassium picrate	50%
Potassium nitrate	50%

Too dangerous by reason of sensitiveness to friction:

Brugére Picric Powder:

Ammonium picrate	50%
Potassium nitrate	50%

Not as dangerous as Designolle powder.

Explosive-gelatine:

Nitro-glycerine	89%
Collodion gun-cotton	7%
Camphor	4%

The different kinds of High Explosives, as, made in Continental Europe, under Nobels Patents.

Dynamite No. 1, old,	Nitro-glycerine	75%
	Kieselguhr	25%
Dynamite No. 2, old,	Nitro-glycerine	50%
Absorbent	Wood-pulp and Saltpetre	50%
Cellulose-dynamite	Nitro-glycerine	75%
	Wood-pulp	25%
Explosive-gelatine	Nitro-glycerine	92 to 93%
	Gun-cotton	8 to 7%
Dynamite No. 1, new,	Explo.-gelatine	60 to 70%
Absorbent	Saltpetre 75% / Wd.-pulp 25%	40 to 30%
Dynamite No. 2, new,	Explo-gelatine	40 to 50%
	Absorbent, as above	60 to 50%
Dynamite No. 3 new,	Nitro-glycerine	15%
Absorbent	Saltpetre 75% / Sulphur 10% / Wd.-pulp 15%	85%
Dynamite No. 3 new,	Nitro-glycerine	25%
Primer)	Absorbent, as in No. 3	75%
Military	Explo.-gelatine	96%
	Camphor	4%

*According to the testimony in the suit of the Atlantic Giant Powder Co. against the Vulcan and the Neptune Powder Companies, the various explosives which the complainant regarded as infringements of their patents are as follows:

Vulcan Powder.		*Brady's Dynamite.*	
Nitro-glycerine,	32.6 per cent	33	per cent,
Nitrate of Soda,	49.46 "	50	"
Charcoal,	9.63 "	10	"
Sulphur,	8.31 "	7	"

Neptune Powder.		
Nitro-glycerine	32.66	per cent,
Nitrate of Soda	45.	"
Charcoal	17.44	"
Sulphur	4.86	"
Ash	0.94	"

Miners' Powder Co. Dynamite.		
Nitro-glycerine	32.91	per cent.
Nitrate of Soda	49.88	"
Charcoal, wood and partially charred wood	17.21	"
Ash	1.18	"

(The percentages are given exactly as in the original).

The injunctions against the manufacturers of Neptune and Vulcan powders were granted. The value of this monopoly may be shown as follows: It is claimed that, with proper exploders, a dynamite composed of 30 per cent. nitro-glycerine and 70 per cent. of meal powder will do as much work as a dynamite with 75 per cent. of nitro-glycerine and 25 per cent. of infusorial earth. The difference in cost may be estimated as follows:

Vulcan Powder.	
70 lbs. of Meal Powder @ .04	$ 2.80
30 " " Nitro-glycerine @ .40	12.
100 lbs. of powder costs	$14.80
Dynamite No. 1.	
25 lbs. Infusorial Silica @ .03	$ 0.75
75 " Nitro-glycerine @ .40	30.
100 lbs. of dynamite costs	$30.75

In a previous suit, Judge Blatchford issued an injunction against the manufacture of the following powders:

	No. 1.	No. 2.
Nitro-glycerine,	67.64.	27.86.
Cellulose (paper stock)	16.82 (sawdust & charcoal).	5.59
Nitrate of Soda	15.54	66.55

Prof. Ch. E. Munroe, U. S. N. A. in Proceedings, U. S. Naval Inst., Vol. X., page 211 (Feb. 1884) mentions a new explosive, called Panclastite, invented by Eugene Turpin, of France. The mixture is made by mixing liquid nitrogen tetroxide ($N_2 O_4$) with combustible substances, such as the hydro carbons; vegetable, animal and mineral oils; fats and their derivatives, but preferably with carbon disulphide. He proposes that the two substances should be kept apart until needed for use, when they may be mixed in the proportions considered best for the work on hand. The proportions which yield the most sensitive mixture are: $2 C S_2 + 3 N_2 O_4$, being about two volumes of the first to three of the second. In making this mixture the temperature falls about 20°. When equilibrium is re-established, the mixture burns with a most brilliant flame if ignited when freely exposed to the air. If confined in a vessel and ignited it burns until the pressure of the gases produces an explosion. Under these circumstances only a portion of the enclosed matter explodes and the remainder burns up quietly. If, however, it be exploded by a fulminate primer, whether enclosed or freely exposed, the explosion is complete and powerful; more powerful, it is claimed, than nitro-glycerine or explosive gelatine. The advantages claimed for this explosive are, greater power than dynamite, perfect safety of the separate constituents in transport and storage, insensitiveness of the mixture to blows, and easy control of the manufacture by the Government, owing to the fact that nitrogen tetroxide is not met with in commerce.

In general, Panclastite is to be used in the liquid state, but if the solid state is preferred, it may be absorbed by infusorial silica, just as nitro-glycerine is.

M. Turpin proposes to utilize the light-giving properties of Panclastite. The heat developed by the combustion is also very great, being estimated at 3.000° Cent. Platinum fuses instantly under the action of this flame, and the mixture can fuse its own weight. Graphite also commences to fuse. Turpin has also devised a furnace by which this great heat can be utilized in the arts.

* (W. N. Hill, Notes on explosives, quoted in Proceedings, of the N. S. Naval Institute, Vol. X. 1884.)

* Prof. Munroe, Proceedings, U. S. Naval Inst. Feb. 1884.

The Channel Tunnel.

The following passage is from a song, "Bubbles of 1825," by Theodore Hook, which appeared in the *John Bull* newspaper in 1825:

"A tunnel underneath the sea from Calais straight to Dover, sir.
The qualmish folks may cross by land from shore to shore,
With sluices made to drown the French, if e'er they would come over, sir,
Has long been talk'd of, till at length 'tis thought a *monstrous bore*."

The following passages in the same song seem worth recording:

"When Greenwich coaches go by steam on roads of iron railing, sir.
How pleasant it will be to see a dozen in a line!"

"For new canals to join the seas, Pacific and Atlantic, sir."

Here we have steam tramways and the Panama Canal anticipated.

[*Notes and Queries.*

CORRESPONDENCE.

Driven Wells.

Special Correspondence Engineering News.

DENVER, COLO., June 23, 1884.

EDITOR ENGINEERING NEWS:—As we are thinking somewhat of putting down a system of "Drive Wells", or "Driven Wells" as a supply source for Water-Works for a town of some 6000 or 7000 inhabitants, I would like very much to get hold of information concerning any systems of this kind, or any experiments in this line. (I think it has been tried in Brooklyn, N. Y.) Can you refer me to anything bearing on the subject. Has the NEWS ever discussed the subject? If not asking too much, will you kindly favor me with an answer.

Very Respectfully,

WALTER H. GRAVES.

[MR. GRAVES is Chief of the Engineering Department of the Colorado Loan and Trust Co., of Denver, Colo. and as such has charge of nine irrigating canals, besides the Silverton and Albuquerque Water-works. He is a good man for people posted in "Driven Well" matters to communicate with. ENGINEERING NEWS has not yet furnished anything of consequence on the subject, but is ready for communications. The city of Brooklyn is now using a system of Driven Wells and probably Chief Engineer Robt. Van Buren, will tell you all about them.—ED. ENG. NEWS.]

What He Figured On.

"It was flaxseed that ruined me," he said, as he crossed his legs and heaved a sigh from the bottom of his soul.

"You tried to make a corner, eh?"

"Oh, no. I was only calculating on the natural and average demand in the middle states."

"And did the price go down?"

"Yes, 15 cents per bushel."

"What was the cause?"

"Almost total lack of boils in the State of Ohio, Indiana, Michigan and Illinois that season" he calmly replied. "The number of boils dropped from 750,000 to three or four old carbuncles and a felon or two, and I'll be hanged if even those weren't poulticed with cornmeal to save expense."—*Wall Street News.*

SOME out-of-the-way data respecting the great canals of the world are published. The Imperial Canal of China is over 1000 miles long. In the year 1681 was completed the greatest undertaking of the kind on the continent, the canal Languedoc, or the Canal du Midi, to connect the Atlantic with the Mediterranean; its length is 146 miles, it has more than 100 locks, and about 50 aqueducts, and in its highest part it is no less than 600 feet above the sea; it is navigable for vessels of upward of 100 tons. The largest ship canal in Europe is the Great North Holland Canal, completed in 1825, 125 feet wide at the water surface, 31 feet wide at the bottom, and has a depth of 20 feet; it extends from Amsterdam to the Helder, 51 miles. The Caledonian Canal, in Scotland, has a total length of sixty miles, including three lakes. The Suez Canal is 88 miles long; of which 66 miles are actual canal. The Erie Canal is 350½ miles long; the Ohio Canal, Cleveland to Portsmouth, 332; the Miami and Erie, Cincinnati to Toledo, 291; the Wabash and Erie, Evansville to the Ohio line, 374.

Mexican Water Works.

GLENWOOD, 23d WARD.
PITTSBURG, PA., June 26, 1884.

EDITOR ENGINEERING NEWS:—In addition to the building of railroads in the neighboring republic of Mexico, which during the past three or four years has assumed extensive proportions, another field for enterprising capitalists has lately been opened in that country. I refer to the building of water-works. At present Mexican cities, with few exceptions, are very inadequately supplied with water. The general mode of supply is by means of stone aqueducts, bringing the water from high reservoirs situated in the adjacent high mountains, nearly every city (as far as I have seen) being located near the base of one.

The city of San Luis Potosi, the capital of the State of the same name and located on the proposed line of the Tampico branch of the Mexican Central Railway, is the first city to move in this important matter. Recently a concession for the building of a system of water supply has been granted to a London company, the details of which I quote taken from a late number of the *Two Republics* published in the city of Mexico.

"The concession received by Messrs. Wastall and Wylie from the State of San Luis Potosi for constructing an aqueduct system was signed on May 6th, and by the terms of the contract the work of constructing the reservoir must begin within four months of its signing, and the laying of the pipes within four months after the opening of the Central railroad between Tampico and the city of San Luis Potosi and 20 months after the road is opened the entire system must be completed. The grantees can organize a company to have its headquarters in the city of London with a local office in the city of San Luis Potosi. Within 9 months the company organized must have at least $100,000 subscribed.

The Executive is authorized to appoint an engineer at the expense of the company with a salary of not more than $200 a month, who shall associate himself with those of the company.

For the faithful fulfillment of the terms of the contract a deposit of $5,000 shall be placed by the company in the branch of the Mexican National bank in San Luis Potosi, which can be withdrawn when the first section of the works is completed, substituting it by a mortgage on that part already constructed.

The company has the right to all the privileges that the State and municipality enjoy by the laws for a period of 50 years, after which the city can make a special contract always giving the preference to the original company.

All materials used in construction will be admitted free of State or municipal duties and the Executive will petition the Federal Government for the removal of federal duties on imported material.

The company is authorized to established one or more ice factories.

The company can collect at the rate of $2.50 monthly (at the most) from each customer who does not take less than 1,200 liters daily. Certain other privileges are allowed the grantees, making the concession a valuable one and the completion of the works will be a great thing for the city of San Luis Potosi. Mr. Wylie has gone to London to work up that end of the project. Mr. Wastall remains in San Luis, Potosi."

The city of Guanajuato, well known as a mining centre has lately found her water supply insufficient for the increased demand upon it. This city is supplied from reservoirs situated near the head of the Guanajuato River, about 2 or 3 miles above the city proper.

The reservoirs are formed by the building of stone dams across the valley and enlarging the space obtained by excavating the rock back of the dam along the sides of the valley, which are there very narrow. There are two large reservoirs and several smaller ones, each varying in altitude one being below the other. The dams are of masonry, well built and durable and of sufficient strength to amply with stand many times the pressure to which they are subjected, in cases of sudden overflow, which often times happens during the rainy season. An exceptional case happened some 12 years when a "*cloud-burst*" occurred immediately above the reservoirs, filling them, overflowing and flooding the valley below and partly inundating the city of Guanajuato.

Notwithstanding the enormous pressure the dams stood firm and were not injured in the least.

The supply of these reservoirs is entirely dependent on the rainfall as the stream which feeds them is entirely dry (not being fed by streams) during the dry season, which comprises 8 months of the year, or from October to June.

The capacity of the reservoirs is only 100,000 cu. meters or a little over 26,400,000 gals. to supply the city for a period of 240 days giving 110,000 gals. daily. I assume the population to be about 55,000, which would give 2 gallons, say 2 *gallons*, daily per capita.

The main distribution pipe from the reservoir to the city, is a lead pipe, and I do not think it is over (3) in. diameter. The rate of incline is about 80 to 90 ft. per mile.

There is no house distribution as with us here, but public fountains at different places in the city, where the water is sold to the aguadores or water-carriers, who have a large earthenware jar, or, sometimes, a small keg or two strapped to their backs, and who peddle their contents in town from house to house, and thus supply the consumers.

I have been informed that the city derives a net income of about $18,000 a year from the sale of water, which, allowing $8.00 for expenses of collection, etc., (the works needing very few repairs), would be at the rate of $1.00 per 1,000 gals. applied.

The rates charged by the aguadores is about ¼ cent to ½ cent per gallon.

The quantity of water used is, however, augmented by the many cisterns attached to dwelling and other houses. The capacity of these, I think, is about equal to the quantity supplied by the reservoirs, which would give a total average daily consumption of 4 gals. per head. Certainly a minute quantity, if we take the amount used in American cities as a basis.

The City of Mexico has lately made provisions to largely increase her present supply, by the building of additional reservoirs, and the laying of pipes in the city and its suburbs where pipes at present do not exist.

EMILE LOW.

An English View of American Inventions.

"We hear occasionally from America," says the London *Timber Trade Journal*, of extraordinary discoveries and inventions which are to revolutionize trade, or to supply the world with new commodities that will render those familiar to us of no value. Three or four years ago timber, better than nature could grow, was going to be made out of straw, and the patent was supposed to have been taken out for it. Then houses were going to be built of glass, of a peculiar kind, and these houses were to be as indestructible as the world itself. But, after a flourish of trumpets, we listen in vain for the gong of public applause which proclaims the success of the invention! Now here is another plausible note of admiration; but will anything come of it? It is reported from the United States that a Pittsburg engineer has successfully applied the vapor of carbon in driving a sixty-horse power engine. The bisulphide of carbon was converted into vapor at a temperature of 118 degrees, produced by steam obtained from a 15 horse-power boiler. Compressed air is cheaper than steam; but when you have to employ steam to obtain it, double machinery is involved in the process, and the expense is doubled too, before you get it into operation, with far less efficiency than using steam direct. The question is, can the new invention be made to pay better than those which it is intended to supersede? or has it other advantages which render the question of costs less important? Science can make sugar out of turnips, but, having established the fact, science discontinues the process because it will not pay to go on with it. So, many of these bright ideas, that come to us from the other side of the Atlantic, die down, and flicker away into oblivion, because when they come to be practically applied they are found to be a little more expensive than the old plan, without producing quite so good a return.

The Drainage and Sewerage of Mexico.

Editors of the *Mexican Financier*.

SILAO, MEXICO, April 22, 1884.

I have read with much interest the article in your late issue by Dr. Archibald Lawson, on the health of the city of Mexico, and particularly that portion relating to the sewerage problem. A few remarks from an Engineering stand-point may be acceptable to your readers many of whom, as residents of the Metropolis, have a vital interest in the sanitary improvement of the city. I will go a step beyond Dr. Lawson's statement that the drainage and sewerage should be considered independent, and assert that the so called "separate" system of sewers, from which the storm-water is rigidly excluded, is the only *efficient* means to be adopted for the sewerage not of only the city of Mexico, but all cities on the plateau, and will endeavor to make the proof clear to the non-professional reader. The plateau of Mexico has the climatic peculiarity of the *wet* and *dry* seasons, while most portions of the United States and Europe have the rainfall distributed, with more or less uniformity, throughout the whole year. It may be assumed that for seven consecutive months in the year no rainfall may occur in Mexico, during which time the sole duty of the sewers would be to carry the sewage proper, and such subsoil water as would be allowed to enter, and here I will state that in the separate system, although the sewers are absolutely water tight, arrangements are made in cases where subsoil drainage is necessary to accomplish that object by laying tile pipe with open joints in the same trench with the sewer, entering the latter at convenient points.

A little reflection will enable the reader to appreciate the fact that a sewer large enough to carry the maximum rainfall during the wet season would be of preposterous dimensions if built to convey the *sewage* alone. I may state that the rainfall is so great a quantity in proportion to the sewage proper that in proportioning the sizes in a given system if the sewers are of capacity to carry the water, there is no allowance necessary for the sewage, which with a consumption of 120 litres per capita per diem will be found to be but about two per cent. of the flow resultant from a rainfall at the rate of 0.025 metres per hour. But the *cost* is not the most important factor in the discussion, the *efficiency* of the separate system being the vital question. Without a tedious theoretical discussion it may be stated that a sewer large enough to carry the rainfall during the wet season, will, during the dry season be *too large* to carry the sewage proper. This may seem an absurd statement, but the reason is evident when the conditions are considered. During the rainy season the sewer is at times taxed to its full capacity, and the water rushes through at a high rate of velocity, carrying all deposits of filth with it, while in the dry season a small, sluggish thread of filthy sewage would trickle on its course, depositing the heavier particles in the sewer. In a short time this deposit would decompose, emitting sewer air, which is now recognized by the medical profession as one of the most insidious agents in the spread of the germs of zymotic diseases. In order to make intelligent to the reader the small amount of sewage proper which these large sewers would be called upon to carry, I will append the results of actual gaugings in a few cases, made by Col. Geo. E. Waring, Sanitary Engineer, of Newport, R. I., for the National Board of Health of the United States.

A sewer in Madison Avenue, New York, with a length, including its branches, of 7000 ft. (2134 metres) the district being about one-half built up with houses of good class, carried at the time of its greatest dry weather flow a stream 3½ in. deep through a notch in a weir 4 in. wide.

A sewer in Providence, 1391 ft. (424 metres) long, draining 41 houses with a population of 267, at its greatest dry weather flow filled a six-inch pipe ⅝ in. deep.

A sewer in Milwaukee, draining 500 houses and a population of 3035 persons, as its greatest dry weather flow filled a 6 in. pipes 5½ in. deep. This sewer is built to carry *storm-water* and is 42 in. in diameter, and is a striking example of the immense provision made for the latter duty, its *area being over* 50 *times* that required for the dry-weather flow.

A sewer in St. Louis 87 in. in diameter drained an area containing 1370 houses occupied by a population of 8200. The greatest dry weather flow of this sewer was carried through a 12 in. pipe, filled to a depth of less than 7 in. A calculation of the actual discharge of this pipe showed that the sewer must have received a very large amount of ground water, and that the public supply must have been most wastefully used, for the discharge was over 1,000,000 gals. per day, or more than 130 gals. for each member of the population; that is, the flow was as great as it should be with a population of over 30,000 using only an abundant amount of water.

In constructing the separate system of sewers, provision is made for efficient daily cleansing the sewers by placing an automatic flushing tank at the head of each *lateral* sewer. This tank holds about 200 litres of water, which can be taken through a suitable orifice from the public water-supply. The object of these tanks is to flush the *first* portion of each sewer, where the flow is not sufficient to prevent deposits from taking place. In sections where the storm-water creates a nuisance, storm-water sewers are built to relieve the district, independent of the other sewer.

While I have endeavored to make clear the superiority of the separate system of sewers for your city, I fear its adoption would be but a partial relief and the drainage of the Lake would be imperative if the sewers were built. As I understand the situation, the surface of the lake Texcoco is but about two meters below the general level of the city, and Mr. Francisco de Garay, the distinguished Mexican Engineer, finds the lake is filling up four centimeters per annum, on an average. Water is found in all parts of the city a few decimeters below the surface, and although it would be perfectly practicable to dispose of the sewage by pumping, the general conditions necessary to health must follow the draining of the lake. I believe Mr. de Garay's plan, which contemplates the draining of the valley, to be the only practicable solution of the question for the radical sanitary improvement of the city. This in combination with the separate systems of sewers, will accomplish all that can be done by the municipality, except the enactment and rigid enforcement of uniform and approved method of sewers connected with houses, and arrangements of interior fixtures, which is a matter of great importance. Probably the sewage could all be used in irrigation without entering the canal draining the lakes at all.

C. M. H. BLAKE.
Civil and Sanitary Engineer.

Sanitary Institute of Great Britain.

EXAMINATION OF LOCAL SURVEYORS, JUNE 5, 1884.

PAPER I.

1. What public laws exist as to the construction of new houses and buildings in respect of height, thickness of walls, general curtilage, and out-buildings?

2. What legal powers can a local surveyor use to compel the laying on of a proper supply of water? In the event of his reporting to his authority that entry for this purpose has been refused, how would he substantiate his report before the magistrate?

3. Describe the powers exercisable by the surveyor of a local authority with respect to ventilation of—(*a*) Buildings, dwelling-houses, and manufactories; (*b*) Sewers private and public. What provision ought to exist to carry out ventilation in each of these?

4. How would you calculate the dimensions of an outfall sewer for a population of 15,000 people, the ground affording a gradient of 1 in 600?

5. Under what circumstances would you adopt a glazed earthenware pipe sewer in preference to one of brick? How would you form a brick sewer in a running quicksand at a depth of, say, 12 feet?

6. Sketch a ventilating chamber, and a manhole, and also a means of flushing a pipe sewer.

PAPER II.

1. Supposing that a new water supply is needed for your district, how would you ascertain the sufficiency or otherwise of any adjacent brook or river to supply the necessary quantity?

2. What is meant by hard water? What sources usually furnish it? and what is meant by total hardness and by permanent hardness?

3. What are the most common causes of pollution of water in wells, in water butts, and in cisterns inside houses, and what steps would you take to prevent pollution in each case?

4. What amount of fresh air must be supplied per hour for each individual for health? To what extent and in what manner does the quantity depend on the size of the room in relation to the number of occupants? Explain by one example how your result is arrived at.

5. Draw up a short set of bye-laws for the proper management of a common lodging house.

6. Describe the manner in which you would construct a macadamised road upon newly filled up ground. Give sketches of the construction of a macadamised road, and show the form of the surface and the falls from crown to channel.

EXAMINATION OF INSPECTORS OF NUISANCES.

1. State the powers of local authorities in regard to dealing with infectious diseases.

2. What is the order of procedure prescribed by the sale of Food and Drugs Act in obtaining for analysis samples of articles suspected of being adulterated?

3. What is a cellar dwelling? Under what conditions may underground rooms be inhabited?

4. What are the characteristics upon which you would decide whether a sample of water should be submitted to the analyst or not?

5. How is cubic space calculated, and how much ought to be given for an adult? What is the amount of cubic space usually required for common lodging houses?

6. A nuisance having been reported to exist in a certain house, what steps would you take? What is meant by a recurring order?

7. In the inspection of a slaughter-house, to what points would you specially direct your attention? What are the requirements of a properly constructed slaughter-house?

8. Describe how you would proceed to investigate defects in a system of house-drainage, and make a short report upon supposed defects in house of, say, £50 rental, with especial reference to the points which more usually are found to prevail.

Texan Railroads.

From the report of Mr. Joseph Nimmo, in reference to the proposed improvement of Galveston harbor, we extract the following matter relating to the railroad system of Texas and the influence they have had upon the material prosperity of that State:

The State of Texas is dependent almost entirely upon railroads for the means of internal transportation. Her rivers are not navigable except for lighters and vessels of the smallest size. The increase of the railroad mileage of the State affords, therefore, a measure of her commercial growth. In the year 1850 there was not a mile of railroad in the State. The increase of railroad mileage since 1860 is as follows:

1860	307
1870	711
1880	3,257
1884	6,166

The State of Texas now stands sixth in the order of magnitude of railroad mileage, among the States of the Union. The number of miles of railroad in Texas, under each separate corporate ownership is shown as follows:

	No. of Miles.	
	Standard gauge.	Narrow gauge.
Missouri-Pacific, or Gould system	2,644	
Southern Pacific system	2,956	
Gulf, Colorado & Santa Fe system	535	
Texas & St. Louis railway		305
Texas & Mexican		176
Austin & Northwestern railroad		60
Texas & Western railway		57
Houston, East & West Texas railway		135
Fort Worth & Denver City railway	114	
New York, Texas & Mexican railway	92	
Texas Trunk railroad	35	
Rio Grande & Pecos		26
Rio Grande railroad		22
Atchison, Topeka & Santa Fe railway		8
Total miles		6,166

The rapid growth of Texas in population and all other evidences of material prosperity has been mainly the result of the construction of railroads in the State.

The actual value of the railroad properties in Texas is about $160,000,000; but to fully utilize these vast transportation resources a first-class sea-port is needed. Galveston is practically the only harbor upon the Texan coast, and by a proper system of improvement could be made accessible to the largest ships. Its use would shorten the rail distance from the Pacific Coast to tide water on the Gulf of Mexico, 300 miles.

Granite Pavements.

Chief Engineer Danenhower, and the members of the Board of Public Works of Cincinnati, O., have been visiting the Virginia granite quarries, a report of which will in due time be made by the Chief Engineer. The *Enquirer* gives the following interview with one of the members:

"Boyce, what kind of a trip did you have among the granite quarries?"

"Well we spent about twelve hours in the quarries, with the thermometer in the nineties. We examined the granite and the manner in which it was worked. The working-men were cutting the blocks for the Washington market, the constructors of which are contracting for several hundred thousand blocks."

"What do they cost?"

"Well from $1.90 to $2 per hundred in the quarries."

"How can the city put down this pavement with the limited amount of money at her command for such purposes?"

"Well, there must necessarily be some legislation in that direction. First of all, say set aside, $350,000 per year for ten years to the street repairing fund; issue $1,000,000 street improvement bonds to be used only on paving the granite in our streets, and then only when the property-owners abutting pay one-half for such improvements. This would make $2,000,000 for granite pavements. Now, to redeem the bonds I would set aside $100,000 per year of the $350,000 in the street repairing, leaving $250,000 for ordinary repairs. In ten years the bonds would be redeemed and all the principal streets paved with granite. We also visited Washington City and inspected the granite pavements already laid, and the constructing of the asphalt pavement."

"What do you think of that?"

"Well, I must confess that it is a splendid pavement for drives. Major Crawford was the contractor, whom I believe, is one of, if not the best, in that city. The cost per yard is $2.50, with the guarantee that he will keep in repair for five years, leaving back a certain amount, for security for conforming to his contract."

"Would you be willing to put down some of this pavement in Cincinnati?"

"Yes, I believe that twenty or thirty miles of this pavement might be put down upon certain streets."

"How do you put it down?"

"Well, they place twelve inches of crushed bowlders in the under stratum, then roll with a steam roller, and cover with asphalt four or five inches thick, covered with sand and finally rolled. The next day it is ready for use."

Conventional Colors.*

PROF. L. M. HAUPT, OCT. 20, 1883.

Brass	Exterior	Gamboge.
	Interior	Dark Indian Yellow.
Brick	Exterior	Lt. red with carmine
	Section	Crimson lake or c'rm'e
		or Dragon's blood.
Brushwood		Green and burnt sienna, marbled.
Buildings		Crimson lake.
Buildings, shadows of		Indigo, burnt sienna & lake.
Cast-iron		Payne's gray.
Clay or earth		Burnt umber.
Concrete work		Sepia.
Contours		India ink, sepia or burnt sienna.
Copper		Gamboge and crimson lake.
Cultivated land		Burnt sienna.
Earth and clay		Burnt umber.
Fir timber		Indian yellow.
Granite		Violet carmine.
Grass		Light Hooker's green (No. 1).
Gravel		Yellow ochre dotted with burnt sienna.
Gun metal		Dark cadmium or orange.
Iron	Cast	Payne's gray.
	Wrought	Prussian blue and indigo.
Lines	Preliminary	Blue.
	Changes in	Red.
	Location, final	Black.
Mahogany		Indian red.
Meadow land		Hooker's green (No. 1).
Mud		Sepia or India ink.
Oak timber		Burnt sienna, grained.
Roads and streets		Yellow ochre and sepia.
Sand		Yellow ochre.
Sky		Cobalt.
Slopes		Sepia with burnt umber.
Steel		Indigo or Prussian blue and lake.
Stone		Sepia and yellow ochre.
Trees	Light	Gamboge and burnt sienna on a green ground.
	Shade	Gamboge and indigo
	Shadows	Burnt sienna and indigo
Uncultivated land		Green and burnt sienna, marbled.
Vineyards		Purple.
Water		Indigo or Prussian blue.
Wood	Exterior	Yellow ochre or raw sienna.
	Sections	Burnt sienna.
Wrought-iron		Prussian blue and indigo.

* From the Reference Book, Engineers' Club of Philadelphia.

WATER.

TO WATER-WORKS OFFICIALS.

Croes' Statistical Tables of American Water-works is the most complete Compendium of Information concerning American Water-works in print. It was published one year ago, and is for the benefit of parties engaged in the Construction, Official Management, or Mechanical Operation of Water-works. If there is any such person, Civil Engineer, Contractor, President, Secretary, Superintendent, or Mechanical Engineer of any Water-works in America, who has use for the book, and who has not got a copy already, we will be pleased to send it to him on receipt of one *five cent postage stamp*, with which to prepay it to his address.

LAWRENCE, MO., is still vigorously discussing Water-works.

THE contracts for the stone work in the Lexington, Ky., Water-works, have been given out, and work has been commenced.

IT has been found impracticable for Decatur, Mich., to get water from a spring on one of their hillsides, but the *Republican* does not believe in giving up the fight.

THE contractors are laying the mains for the Lexington, Kan. Water-works, although the project has not yet been authorized by the voters.

THE new water-works at Pittsfield, N. H. will have reservoirs with a capacity of 50,000,000 gallons, an average head of 175 ft. and over five miles of pipe.

WINONA, MINN., June 17.—The City Council has ordered the extension of a mile and a half of water mains.

RUMFORD FALLS, Me., has the best water power in the State, although as yet unimproved. When the flowage for three miles back is obtained a stone dam will be built.

IT is estimated that the proposed dam across the Mississippi river at Brainerd, Minn., will be 360 ft. long, and that the river will be raised 20 ft. making available an 8,791 horse-power force. The cost of the work complete will probably be $250,000.

IN order to prevent the constant inundations of the fertile plains of Murcia, Lorca, and Totana in Spain, an immense overflow sewer, or, as the author of the scheme terms it, "subterranean tunnel," is projected to convey the surplus water to irrigate the district round Cartagena.

A CONNECTICUT paper relates this as one of the oddest effects of the drought reported from Stamford; "A church organ there is blown by water-power. The other day at a wedding the supply gave out in the middle of the wedding march, and the music squeaked itself away into silence while the bridal procession was moving up the aisle."

A WATER curtain has been established at the Grand Theatre, Munich, to guard against fire. It consists of a wide thin stream continuously poured from the top of the stage between the acts, completely enclosing the stage in a transparent curtain, and it was owing to this precaution that a recent fire which broke out during the performance of *Tannhauser* was checked immediately. The Vienna Opera has been fitted with a similar apparatus.

THE laying of the corner stone of the Court House was appropriately celebrated at Belton, Tex., June, 24. At an informal test of the water-works a vertical stream from a one-inch nozzle was thrown eighty feet, with a pressure of eighty pounds, one and one-half mile from the pumps. With a larger nozzle, the stream in the same proportion would have been thrown 120 feet. Each one of four streams, thrown from the standpipe alone, with the imperfect appliances at hand went to a height of sixty feet.

The contract to construct the systems of water-works for Pittsfield N. H. was awarded to D. Goff Phipps of New Haven, Conn., and N. W. Ellis, C. E., of Now York on the 30th of May, and preparations are now being made to begin work, so that Pittsfield will be plentifully supplied with water in the course of a few months both for fire service and domestic purposes. The supply of water is obtained from Berry pond and is of the best quality, free from all impurities. It will be brought into the village under a good head and large quantity. The pipe which is to be laid is manufactured by Mr. Phipps, the patentee and owner, and one of the contractors for the work. It is used largely in New Haven, Conn., and several other cities and towns and was selected by the Pittsfield Aqueduct Co. after a careful investigation of the merits of several kinds of water-pipe. There will be a reservoir to construct and some five miles of pipe to lay in order to complete the work. —*Communicated.*

PHILIP BUEHNER, of St. Paul, Minn., received the contract for putting in the entire water-works at Spokane Falls, Wash. Ter. He has ordered two ¾ million gallon pump and hydrants from the Holly Manufacturing Co., and shall use wrought-iron pipe. The Spokane River has a fall of nearly 180 ft. in about 2,500 ft. and furnished a splendid power.

CORPUS CHRISTI, Tex, June, 23.—The committee appointed by the City Council last week to inquire into the different methods of water-works, to-day made a report to the council rejecting all the methods and bids, and advising the council to purchase a new fire engine for the city till a better system than any which has been presented could be devised. Some citizens favor works for the use of fire only, while others desire fresh water, which would cost fully $200,000, as the mains would have to be laid seventeen miles to a point on the Nueces River, which would give a fall of about 300 feet. This distance would be necessitated on account of the tendency of the Nueces River to become salty during dry weather for several miles up stream.

NEWS OF THE WEEK.

Miscellaneous.

THE survey preliminary to improving the Lynn, Mass., harbor has been commenced.

THE Pittsburg Bridge Company is now shipping the iron for a street bridge in St. Louis to be 1500 ft. long, and is full of other work.

FIFTY-TWO, sixty-one and seventy-eight cents per foot were the prices at which contracts for building lateral sewers were recently awarded by the Board of Public Works, Detroit, Mich.

THE long frame bridge across the Delaware at Trenton, N. J., was destroyed by fire June 25th, Loss $40,000. The Bridge was the property of the Trenton City Bridge Co.

THERE were twenty-six bids for building the Marshall county, Ia., court house, ranging from $110,000 to $140,000. It is possible that new propositions will have to be invited, as the bids are considerably above the appropriation.

THE bill providing for an expenditure of $500,000 on the sewers of the District of Columbia, has now become a law, and contractors will be interested to know that the amount to be spent here on sewers during the coming year will be nearer $600,000 than $500,000.

THE Newark and New York Ship Canal Company have offered to connect their proposed canal with Bound Creek, with a view of carrying off the sewage of Newark. The company wants $100,000 per mile, which would probably bring the total cost up to $2,500,000.

THE Keystone Bridge Works is building for the Louisville and Nashville Railroad Company, to be located on the Ohio River at Hemlors, Ky. The total length of it will be 3676 ft. consisting of fourteen spans, for which it will require 3800 tons of steel and iron. The combined length of both bridges is 10,506 ft. or 54 ft. less than two miles long, with a total weight of over 9000 tons.

IN a paper read at the last meeting of the Institution of Civil Engineers, on Tuesday, Sir J. W. Bazalgette stated that the aggregate length of the streets of London was 1965 miles, of which, excluding 248 miles in course of formation, 1718 miles were thus maintained by various authorities; Macadam, 573 miles; granite, 280 miles; wood, 53 miles; asphalt, 13½ miles; flint or gravel, 798½ miles.

FOR building a screw steamer for the Government to be used in the service between this city and the proving grounds at Sandy Hook where newly manufactured guns are tested; to be 118 ft. 6 in. long, with 22 ft. breadth of beam, and a water draught of 8 ft. 6 in. The Atlantic Works, of East Boston, offer to construct an iron boat of that description for $40,789; the Pusey & Jones Co., of Wilmington, Del., offer to build a steel boat for $45,600, and James D. Leary offered to build a wooden boat for $44,950. The bids were all sent to the Quartermaster-General in Washington.

INVENTORS are generally ill-used in this country. In the use of gas for heating purposes, for instance, there is abundance of scope for ingenious inventions to economise the gas; but how does the country treat the inventor? A gentleman of the name of Edwards appeared at the Middlesex Sessions recently to explain his arrangement for effecting a great saving in gas by joining his pipe to the company's pipe on the wrong side of the meter, and got "six months' hard labor." How can we expect to hold our own against America, when native talent is treated in that way?—*London*, Eng. paper.

PORTLAND, PENN., June 27.—A number of new Directors were elected at the annual meeting of the Pennsylvania, Slatington and New England Railroad yesterday, and to-day it is announced that they have become Directors with the intention of completing the road through from the Lehigh Valley to the Hudson River by way of this place. The company have been unfortunate heretofore, after having built the roadway built bridges, and laid rails over one-half the route.

BRENTHAM, TEX., June 23.—The County Commissioners Court, in special session, to-day awarded the contract for building a new court house for Washington County. The building is to be finished on or before August 1, 1885, and is to be built of Houston or Austin brick, according to the plans and specifications made by the architects, Preston & Son. The following were the bidders and their figures: F. B. & W. S. Hull, $80,500; Piper & Dietz, $73,195; J. A. Wilkinson & Co., $58,712; John Meyers, $57,900; John Waite and Alexander Gardner, of Austin and San Antonio, $58,000. The last named firm were awarded the contract, they offering to accept in part payment court house bonds of the county at par to the amount of $35,000, said bonds bearing 6 per cent. interest, the balance to be paid in cash as the work progresses.

Railroads and Canals.

THE Fargo, Larimore and Northern R.R. Co., will begin surveying at once, and will grade from Fargo, Dak., to the Goose River.

WORK is being rapidly pushed in repairing the break in the Southern Pacific. Fourteen miles of road have been rebuilt and the remaining eight will be finished by July 8th.

AT a recent meeting of the stockholders and board of directors of the Texas Mexican railway the main offices of said road were removed from Corpus Christi to Laredo.

THE contract for the construction of the new Court House, at Madison, Wis., has been let to David Stephens, of Madison, at $133,750. The building is to be completed by April 1, 1886.

THE Post Office Department has in preparation a railroad map of all the railroads in the United States. The map will give the most accurate outlines of routes taken by the different railroads.

IT is asserted by railroad men that a preliminary inspection for the survey of the proposed transcontinental narrow gauge line has been made, and that the project will be put in definite shape within a few months. The company is seeking to interest Eastern capitalists.

THE track tanks on the Philadelphia, Wilmington and Baltimore Railroad, near Edgewood, are nearly ready for use. They will enable the fast trains to take up water without stopping, as has been done for ten years past on the Pittsburg branch of the Pennsylvania Railroad.

THE construction of the Southern Extension of the Denver and New Orleans road will soon be commenced. The Denver *Tribune* says that as soon as the shovel is put into the earth at Pueblo by the Denver and New Orleans, the construction of the Canyon City and Denver will also be commenced.

DUBUQUE, Iowa June 24.—The permit to build a pontoon bridge at Dubuque was received to-day from the Secretary of War, and Major McKensie of Rock Island, is appointed to superintend the work. As soon as the company is ready to commence the work a meeting of stockholders will be held to provide for the immediate construction of the bridge.

MR. JOHN PORTER, an engineer on the Illinois Central Railroad, some time since invented an attachment for steam cylinders which condenses the waste from the steam-cock on starting the engine, thereby averting that hissing noise which is to disagreeable to the ear and such a terror to horses. The condenser has been satisfactorily tested by the Michigan Central and Iliinois Central Railroads, and recently the inventor was offered $47,000 for his patent.

LEAVENWORTH, KAN., June 23.—Under the recent act of Congress for another bridge across the Missouri river at this point, a company was formed in this city to-day and the following officers elected: President, Senator Caldwell, Vice-president, L. S. Smith; Secretary, Paul E. Havens; Treasurer, M. H. Insley. The officers and directors comprise the leading business men and capitalists of the city. Work will commence at once.

ARCHITECT GAUGER has been requested to draw up a plan of the Union Depot at St. Paul Minn., by the Committee on Rebuilding, according to certain suggestions by the committee as to alterations.

MARK E. PARRISH and S. J. Munn, of Niles, Mich., have succeeded in nearly perfecting an electric railway signal by which a collision between trains will be rendered absolutely impossible. The above gentlemen are the patentees and C. W. Millard, of the same place, has purchased one third interest in it. Numerous experiments have been made by the parties in Jackson in the presence of railroad officials, members of the press and others, and everything worked to the satisfaction of all parties. These gentlemen say they will have no trouble in operating a telephone between trains of the same circuit; for the instant another train comes on, the circuit is formed and the bell in the cab of each engine will ring, the same as in any telephonic connection. It will also enable the trainmen to communicate with the stations each way in case of accident.

AMERICAN RAILROADS IN MEXICO.—A special to the Galveston *News* from Laredo says: "Information received direct from the city of Mexico gives the startling news that American railroads in Mexico are to be handicapped by a law requiring that all railroads in that country be required to fence the entire length of their lines on both sides, the fences to be so constructed as to prevent even goats from getting on the tracks. It is estimated that the Mexican Central Road would have to expend $5,000,000 to comply with such a law. The Mexican Government has appointed an Inspector of Railroads, whose duty is to supervise and regulate train schedules. No special train can be run without first obtaining his consent."

EAST INDIAN RAILWAYS.—The Select Committee of the House of Commons, presided over by Mr. W. E. Baxter, for inquiring into the best means for the more rapid extension of railway communication in India, again met yesterday.—Mr. Waterfield, Financial Secretary to the India Office, examined by the Chairman, said that according to the Government proposals there would, in the next five years, be an average annual outlay of 3,864,-000*l*., and by companies of 3,428,000*l*., making a total of 7,292,000*l*.; and in the next five years the proposals involved an outlay of 38,212,000*l*. on canals and railways, as compared with 30,000,000*l*. spent in the last five years, the amount to be expended on railways being 20,792,000*l*. The Government was to borrow 2,729,000*l*. a year. and the companies 3,254,000*l*. The Committee adjourned.—London *Standard*, June 16th.

GERMAN RAILWAYS.—From statistics published by the German Railway Department we copy the following figures: the aggregate length of all the roads in operation is 58,340 kilometres; the number of stations, 5,415; railway officials and employees, nearly 290,000; locomotives, 11,000 passenger cars, 20,000, and freight cars, 226,000. The 11,000 locomotives ran during the year over more than 312,000,000 kilometres of ground, averaging about 28,300 kilometres each. All the cars in a row would make a line of nearly 864 kilometres in length. The total amount of capital invested in all these railroads is estimated at 9,000,000,000 marks; receipts, 922,000,000; expenditures, 515,-000,000; annual excess over expenditures, 407,-000,000 marks, equal to about 4½ per cent. interest on the capital. As an evidence of the security of life and limb on German railways the showing is a very favorable one, viz.: One death to every5,590,000, and one injury to every 2,500,000 of passengers.

DECLINE IN R.R. STOCKS.—Taintor and Holt of New York, in a careful analysis of the prices of railroad stocks, estimate the total depreciation in the value of all quotable railroad securities from July 1, 1881, to March 1, 1884, at $1,185,520,181. The depreciation since March 1st must make the total over $1,500,000,000. The following figures will give some idea of the enormous depreciation in some of the leading securities since March 1st: Vanderbilt, $50,000,000; Gould, $70,000,000; Huntington stocks, $20,000,000; six other active securities, nearly $40,000,000. The depreciation in New York Central stock since March 1st is about $18,000,000; in Lake Shore, $15,000,000; in Michigan Central, $6,800,000; in Northwestern, $9,600,000; Lackawanna, $7,500,000; Louisville and Nashville, 6,000,000; Kansas and Texas, $3,700,000; Texas Pacific, $4,100,000; Union Pacific, $2,700,000; Wabash, $2,400,000; Western Union, $19,200,000; Central Pacific, $16,800,000; Chesapeake and Ohio, $1,200,000; Denver and Rio Grande, $4,900,000; Erie, $9,200,000; Northern Pacific, $1,400,000; Pacific Mail, $3,200,000; Reading, $10,700,000; Rock Island, $8,600,000,

RECENT contracts for steel rails were made abroad at 141 to 143 francs 50 cents. Small lots went at 148 to 152 francs.

BERRIEN SPRINGS, Mich., June 28.—The project which was nearly perfected with New York capitalists, to extend the St. Joseph Valley Railroad from this place to St. Joseph and from Buchanan to South Bend, has fallen through, owing to the persistency of Buchanan parties that certain conditions of a money nature immediately interesting themselves be complied with. This, however, does not defeat the enterprise, but only delays the extension, which would have been completed both ways by December 1, next.

THE *English Mechanic* says: Although the average speed of trains in the United States is 20 per cent. below the mean speed of trains in this country, all things considered, the service controlled by the American engineers compares favorably with any in the world. The American engineers at first copied English builders and made locomotives with single drivers; but, as is their wont, they quickly made improvements, and we are not disposed to dispute with Mr. Edwards the dictum that the American locomotive of to-day is "one of the most perfect pieces of mechanism wrought out by the hand and mind of man."

ELEVEN hundred men are at work on the new road from Delmar on the line of the P. W. H. B., R. R. to Cherrystone Iniet, thirty-five miles by sea from Norfolk, Va. It is progressing at the rate of a mile a day. Forty miles have been completed and the rest will be done in September. Two boats, to cost $250,000 each and able to carry twenty-four cars, will do the ferriage between Cherrystone Inlet and Norfolk, Virginia. Travelers who formerly left Norfolk in the evening landed in Baltimore the next morning. When the new road, the "New York, Philadelphia and Norfolk, is completed, those who leave Norfolk at night will be able to breakfast in New York the next morning."

CATALPA TIES.—The catalpa is already in use in the Southwest to some extent, for railway ties. It is a wood of rapid growth, and yet has shown remarkable durability. In an address before an agricultural society in Ohio, Gen. Harrison, of Indiana, told of a catalpa footlog over a small stream in the Wabash country which had been in use for 100 years, and was still sound, showing no sign of decay. There are many well-authenticated reports of catalpa fence-posts which have been set fifty years or more and still show no signs of decay. It is generally believed by those who have had a life-long experience with it that it will outlast any other timber in use, not even excepting red cedar.

MESSRS. M. A. WOLF, R. J. Lackland, Alexander Hamilton, J. P. Keiser and Miles Sells, the incorporators of the company for the construction of a railway along the river front at St. Louis, Mo., have filed their bond with the Secretary of State, and have received their articles of association from Jefferson City. The gentlemen named will meet in a few days and arrange the permanent organization of the company. The new line will be six miles long, extending from the Water-works at the north end to the Arsenal in the south. There will be a double track of standard gauge. As the merchants and manufacturers along the route are strenuously urging the incorporators to lose no time in completing their undertaking, the work will be commenced on the 1st of July. It will be carried out in sections, and the whole length, it is expected, will be completed by the 1st of January next.

HARRISONBURG, Va., June 26.—A meeting of the incorporators of the Massanutten and North Mountain Railway Company was held at this place Wednesday night. An organization under the charter was effected, by electing Hon. Henry C. Allen, chairman, and Frank King, Esq., secretary. A committee consisting of Hon. Henry C. Allen, Messrs. J. D. Price and Frank King was appointed to confer with the presidents of other roads, looking to the building and equipping of this line. The proposed route is from Strasburg, Va., where it will connect with the Orange and Alexandria Road, to Columbia and Mount Vernon Furnaces in Shenandoah County, thence to Orkney Springs, thence to Rawley Springs, thence to the Dora Anthracite coal fields, thence, via Monterey, in Highland County, to the West Virginia line; thence to some point on the Ohio River. The prospect for an early completion of the road is good and when finished will place the anthracite coals in the Philadelphia market at a cheaper price than the Lykens Valley coal of Pennsylvania. The road traverses the best mineral, timber and grazing lands of Virginia. The company will be formally organized in August.